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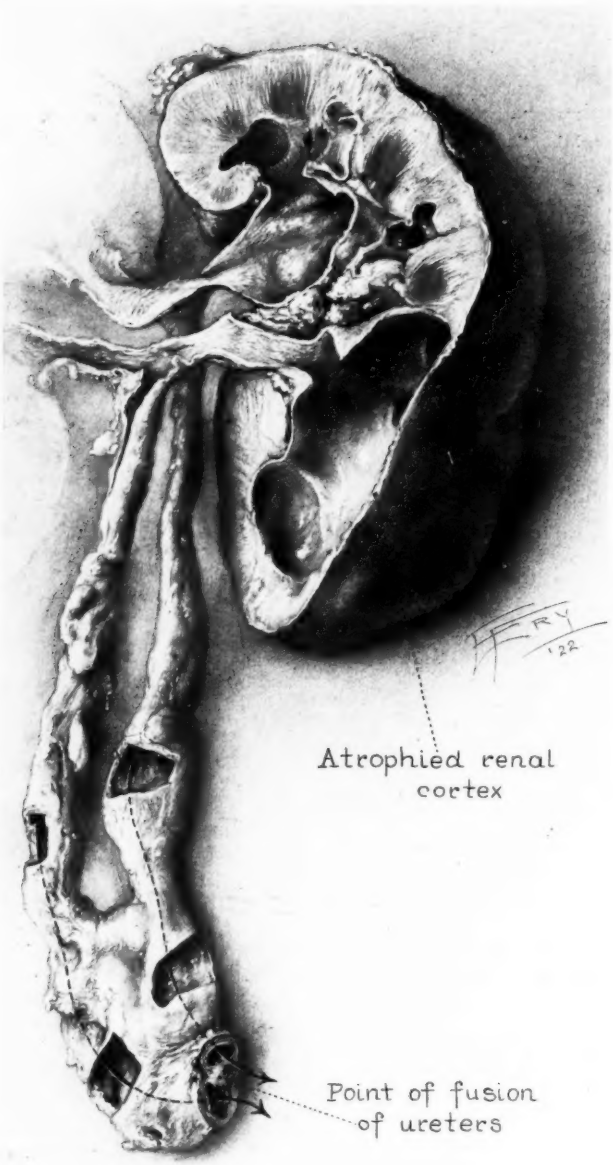

Fig. 10. (Case 5-A81801.) Extensive hydronephrosis of both segments of a double kidney. The ureters are fused at the ureterovesical juncture.

Pathological Complications with Duplication of the Renal Pelvis and Ureter.—William F. Braasch and Albert J. Scholl, Jr.

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PATHOLOGICAL COMPLICATIONS WITH DUPLICATION OF THE RENAL PELVIS AND URETER (DOUBLE KIDNEY)[1]

BY WILLIAM F. BRAASCH, M.D., ROCHESTER, MINNESOTA
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ANOMALIES in the urinary tract of themselves are of no clinical significance. It is only when some pathological complication occurs that their recognition becomes of clinical as well as surgical importance. Pathological, and particularly surgical, complications are prone to develop in the presence of such anomalies, and their clinical discovery is, therefore, comparatively frequent.

The most common anomaly in the urinary tract is duplication of the renal pelvis and ureter; such duplication may be unilateral or bilateral, complete or incomplete. When it occurs in a solitary kidney, it is usually termed fused or horseshoe kidney. That duplication is comparatively common is evident from the literature; in fact, it is so common that its discovery is not generally reported unless some unusual incident accompanies it. An excellent review of 300 cases largely collected from the literature is given by Mertz in a recent series of papers. It is of interest that in 27 per cent of these cases the duplication was bilateral. The comparatively high incidence of ectopic ending of the duplicated ureter as reported in the literature is also of unusual interest; this occurred in 42 (30 per cent) of a series of 140 patients having complete ureteral duplication.

One hundred forty-four patients with duplication of the renal pelvis and ureter were observed in the Mayo Clinic from 1907 to 1922. The conditions were divided anatomically into unilateral, 135 (94 per cent) and bilateral, 9 (6 per cent). The duplication of the ureter was subdivided into complete unilateral, 36 (25 per cent); incomplete unilateral, 99 (68.7 per cent); complete bilateral, 8 (5.5 per cent), and incomplete bilateral, 1 (0.7 per cent). In the complete unilateral duplications, there was an ectopic ending of the duplicated ureter in 3 cases (2 per cent). Doubtless the relative occurrence of bilateral duplication reported in this series is not exact, particularly in relation to the occurrence of partial duplication of the ureter. Nevertheless, it is hardly possible that the percentage of error in our cases would approximate the bilateral occurrence of 27 per cent, as found by Mertz.

The comparatively large number of patients with bilateral duplication which have been reported in the literature may be explained by the fact that this unusual condition is reported, while the more ordinary unilateral occurrence is not. The comparatively common occurrence of ectopic ending of the duplicated ureter as reported in the literature probably is also exaggerated and can be similarly explained.

[1] Presented before the Urologic Section, New York Academy of Medicine, New York, February 15, 1922.

ANATOMY

The position of the kidney with duplicated pelvis and its relation to the surrounding tissues are usually normal. The double kidney which is usually larger than normal varies in size, as a rule, with the distance separating the pelves. The two renal segments are generally separated externally by a depression which varies from a shallow notch to a deep broad groove; occasionally this external evidence of division may be lacking, or it may be so marked that only a fibrous band unites the two segments, as in a case described by Marion. Although there may be a definite external division of the two renal segments and the pelves may be widely separated, our microscopic examination of the intervening tissues showed that there was no apparent division in the cellular structure of the two segments. In an occasional case the two pelves are so close together that a partial resection is impossible. When external demarcation of the two segments exists, the upper segment is, in most cases, smaller than the lower. Even though the double kidney is somewhat larger than ordinary, the combined renal function of the two segments is generally normal. Although there is usually a difference in size between the pelves of the two segments, we have found that the differential function of one segment is usually equal to that of the other. In two instances the phenolsulphonephthalein return from each segment was 7 per cent in 15 minutes.

The division of the tip of the renal bud into the branches of the renal pelvis may give rise to a great variety of forms. The usual short cleavage of the ureteral bud sometimes continues and forms partial duplication of the pelvis. One of these divisions or calices (usually the cephalad) may form a pelvis as large as the original. As a result of ureteral obstruction in this type of case, hydronephrosis, when it occurs, will involve both pelves. Duplication of the pelvis may be said to be complete only when the several pelves or their portions have separate ureters or ureteral divisions. Sometimes the renal bud divides into three or four separate elongated calices, each of which has a separate branch running to the ureter; these unite just beyond the hilum without forming a true pelvis. In one of the cases of this series (Case 9-A308206) the pelvis was entirely extrarenal, situated about 6 centimeters from the hilum of the kidney, and above it the two major calices extended into the renal substance, where they divided into the minor calices. Occasionally, the ureteral divisions leading from the duplicated pelves will unite close to the kidney, or even within the kidney, so that resection or division of the ureter is obviously impossible (Fig. 1).

In cases of complete duplication of the ureter, crossing often occurs just above the bladder and also below the ureteropelvic juncture; but this is probably not of clinical importance. Often there is only one crossing or none at all; occasionally the two ureters are wound around each other, or they are in close apposition and may be inclosed partially or entirely in a common sheath, adding greatly to the difficulty of preserving the sound ureter following a partial resection of the kidney with the attached ureter. As a rule, the ureters leave the pelves at a normal angle; in incomplete duplication the ureteral division may occur at any level. In our series the upper one-third of the ureter was most often duplicated (Fig. 2). Ectopic ending of an aberrant ureter has been described as occurring in the vagina, urethra, seminal vesicle, ejaculatory ducts, and in the anatomical areas represented by the permanent disposition of the wolffian duct. In our series, ectopic ending was found in the urethra in two instances and in the vagina in one.

HISTOLOGICAL STRUCTURE

Sections taken from the interrenal tissue in most cases show complete histological unity of the two segments. In some cases the capsule dips down into the renal mass, causing a partial division of the renal tissue. In the specimens examined glomeruli were commonly found in the parenchyma between the two pelves. In one case the tubules of the two segments were adjacent but definitely separated, each associated with its own glomerulus. Various transitions from an almost complete separation by fibrous tissue to an indistinguishable intermingling of parts were

Fig. 1.

Fig. 1. (Case A199670.) Partial duplication of kidney with normal minor calices.

Fig. 2.

Fig. 2. (Case A241859.) Duplication with fusion of ureters in the upper third.

Fig. 3.

Fig. 3. (Case A331059.) Complete unilateral duplication of kidney with a small upper and a moderately dilated lower pelvis.

found. In cases of infection the intervening tissues invariably showed round-cell infiltration and fibrosis, and in a few, destruction of the parenchymal or tubular cells. These pathological cellular changes extended into the apparently normal segment to a variable extent.

DIAGNOSIS

As a rule, under normal conditions, complete duplication of the pelvis and ureter can be diagnosed with comparative ease. The condition is usually recognized by cystoscopic inspection, or more definitely by the aid of lead catheters and the pyeloureterogram (Fig. 3). If the duplication of the ureter is incomplete and occurs above the bladder it cannot be discovered unless a routine pyelo-uterogram is made. The presence of a pathological complication in one or both segments and the resulting deformity may render recognition of the condition exceedingly difficult.

Cystoscopic inspection. The cystoscopist, accustomed to finding one ureteral opening on each side of the trigone, does not usually look for a third. The careful observer, however, should always be on the lookout for the third orifice. The duplicated orifices are usually situated at the normal site in the lateral portion of the trigone, separated by a distance of 1 to 2 centimeters. They are both, as a rule, easily seen in the normal bladder in the comparatively small field of the direct vision cystoscope. The openings may, however, be very widely separated and are occasionally situated in unusual portions of the bladder. When they are widely separated, the cystoscopist is not always to blame for failure to find the supernumerary orifice, and consequently overlook the duplication.

An aberrant ureter, opening into the urethra or vagina, may be difficult to find, but the use of indigocarmine, as suggested by Mertz, facilitates the discovery. Since urinary incontinence is present in this condition, every case of incontinence which is not otherwise explained should suggest the possibility of the ectopic opening of an accessory ureter.

If pathological complications have not obscured the opening of the diseased ureter or caused marked abnormality in the bladder, the duplicated openings will have no unusual

Fig. 4. a, Catheterizing guide for three catheters. b, End of catheterizing guide.

characteristics. Occasionally one or both may be small, or situated on a slight papilla and easily overlooked. Slight depressions may be visible in the mucosa adjacent to an orifice which may be suggestive of a duplication, and thus confused by an over-zealous observer. A ureteral orifice in or adjacent to the sphincter may easily be overlooked, particularly if the average lens cystoscope is used. When the ureter is divided above the bladder, there is, of course, but one orifice and this will not present any peculiarities suggestive of duplication. Complete bilateral duplication of the ureter and pelvis, with four ureteral openings in the bladder, should be no more difficult to recognize than unilateral duplication. The two ureteral openings may be found in the usual position on each side of the trigone. If tuberculosis involves one pelvis and ureter, the resulting contraction of the ureter may place the duplicated openings in unusual positions. As the result of the infection, deformity of the bladder and changes in the mucosa adjacent to the affected orifice may obscure them. In cases of atrophy of the ureter leading from a functionless renal segment, the orifice may become obliterated.

Ureteral catheterization. Data obtained by means of the ureteral catheter alone in cases of complete unilateral duplication of the ureters is not of much practical importance, except with regard to the existence of pathological complications in the ureter. The usual method of catheterizing the three ureters consists of a preliminary catheterization of one, followed by removal of the cystoscope and its reintroduction in order to catheterize the other two. The procedure, which may be attended by technical difficulties and discomfort to the patient, can be obviated by the use of a three-catheter guide which we have constructed in order to permit simultaneous catheterization of the three ureters (Fig. 4). The question may arise, in cases of duplicated pelvis, as to whether there is a direct connection between the two pelves. This can readily be ascertained by injecting a solution colored with methylene blue into one catheter; if the dye returns immediately from the second catheter, it is quite evident that the separation of the two pelves is incomplete. Further corroboration is available by means of pyelography. If the two ureters unite soon after leaving their respective openings, as occurred in one case previously reported (2, 3), the second catheter introduced will meet the obstruction at the point of union. If there is a single opening and the ureter is divided in the upper portion, obstruction, or any other evidence of the division, is seldom found by the ureteral catheter.

It is often of value to estimate the comparative function in the two segments of the double kidney. In the diseased segment the extent of the pathological process may be estimated, if the dye secretion is absent or greatly diminished. Of even greater value is the determination of the degree of function in the supposedly normal segment. If the return of the dye from this segment is greatly diminished, heminephrectomy should, of course, not be considered, even though the exterior of the segment appears fairly normal.

Pyelo-ureterography. More exact data concerning the anatomical structure of the duplicated pelvis and ureter, as well as of pathological complications, may be obtained by combining the roentgen-ray and the cystoscope as in the pyelogram and the ureterogram (Figs. 5 and 6). If duplication is complete, the lead catheter will outline the course of the two ureters and the position of the two pelves in the pyelo-ureterogram. The lead catheter will be of little value, however, if the ureter is divided above the bladder, since it can follow but one branch. The pyelo-

Fig. 5. (Case A203833.) Opaque catheters inserted into both pelves of double kidney. The lower pelvis injected with sodium bromide.

Fig. 6. (Case A296690.) Complete bilateral duplication. Opaque catheters inserted in right ureters. Pelves of the left kidney injected with sodium bromide.

ureterogram offers the only method by which such partial duplication can be determined (Fig. 7). With incomplete duplication of the ureter, even though the end of the catheter is in one of the pelves, the injected bromide solution will usually flow back alongside the catheter so as to outline the divisions of the ureter and the second pelvis as well. When the ureteral division is close to the bladder, the second ureter may be outlined by reinjection through the partially withdrawn catheter, as is routinely done at the clinic in pyelo-ureterography.

The relation of the two pelves as outlined in the pyelogram may be of value in determining (1) the distance separating them, (2) direct communication, and (3) the relative size. By routine pyelo-ureterography at the time of cystoscopy, incomplete duplication undoubtedly will be discovered more often in the future. It is of practical importance to ascertain as nearly as possible the amount of tissue separating the two pelves, since if there is considerable, surgical separation is much easier. There is usually a marked difference in the outline of the two pelves, as well as in the size. The smaller pelvis is usually situated cephalad and its calices are smaller than normal in size and contour (Fig. 8). If a small pelvis is outlined in the pyelogram and, particularly if it is high lying, the possibility of duplication with occlusion of the other ureter and pelvis must be considered and a search made for evidence. Obliteration of one branch of a double ureter may be surmised when the branch of the ureter leading to the normal pelvis is smaller than the combined ureter. The point of ureteral division may be indicated by a localized irregularity in cases in which the smaller normal branch leaves the combined ureter. Even though data from cystoscopic inspection and ureteral catheterization are negative, the existence of duplicated pelves and ureters must be considered, if (1) the patient's recent history is suggestive of renal involvement; (2) there is much pus in the urine without apparent cause, being found on cystoscopic

inspection, or (3) there are shadows suggestive of stone in the renal region which are apparently excluded in the pyelogram. The duplicated ureter or pelvis may become occluded so that cystoscopic data are negative and the pyelogram does not show the duplication. In case of recent occlusion of one branch of a duplicated ureter, it is easily possible that a pathological complication in the involved pelvis would be overlooked. In a pyelogram the shadows of stones or of a calcareous area of tuberculosis situated in the occluded portion of the double kidney might appear to be extrarenal because of their distance from the outlined pelvis (Fig. 9). The same error would, of course, arise in the presence of complete duplication of the ureter when the second orifice is overlooked on cystoscopic examination.

PATHOLOGICAL COMPLICATIONS

Mertz found that pathological complications occurred in 80 (30 per cent) of the 300 cases reported. The 144 patients in our series may be divided, according to incidence of pathological conditions, into: Group 1, those who were operated on, 30; Group 2, those having definite pathological lesions who were not operated on, 24; Group 3, those in whom the evidence of pathological lesions was doubtful, 29; and Group 4, those without evidence of pathological complication in whom the discovery of the condition was purely accidental, 61 (42 per cent). Fifty-four (37.5 per cent) of the 144 patients were found to be suffering with definite pathological complications (Groups 1 and 2).

In the 30 patients in Group 1 who were operated on, the various lesions described were: ureteral obstruction with hydronephrosis or pyonephrosis in 8, renal tuberculosis in 6, renal lithiasis in 7, ureteral lithiasis in 3, and atrophic pyelonephritis in 4. In one case the aberrant ureter from the upper segment opened into the vagina; in another an anomalous vessel crossed the ureter causing obstruction. The lower segment of the kidney was primarily involved in 9, and the upper in 5; both segments seemed equally involved in 13. It is evident that the pathological complication is confined largely, if not entirely, to one segment in about one-half of the cases, and, furthermore, that the lower segment is more often affected than the upper.

Of the 24 patients in Group 2 who were not operated on, essential hæmaturia occurred in 4, unilateral infection in 2, bilateral infection (one incomplete bilateral duplication) in 9, ptosis in 3, ureteral stones passed after manipulation in 3, and stone in the lower pelvis of a double kidney, left intact because of various complications, in 3.

The fact that 15 of the 24 patients had chronic renal infection, is suggestive of possible lowered resistance because of the anatomical deformity. The three stones removed by manipulation were all near the ureterovesical juncture and not related to the division of the ureter.

The 29 patients, in whom no definite evidence of disease was determined, had attacks of pain suggestive of renal colic referred to the renal and ureteral areas. In many cases the pain was accompanied by fever and chills with temporary urinary symptoms. Neither by cystoscopic examination nor urography could definite evidence of a lesion be demonstrated, although in several instances the pyelogram showed moderate distention of the calices. General examination did not reveal extrarenal cause of the symptoms in the majority of cases. It would seem logical to assume that the anatomical deformity was subject to temporary urinary obstruction or infection.

SURGICAL TREATMENT

Thirty operations were performed on patients with duplicated pelves as follows:

	Cases
Nephrectomy	15
Heminephrectomy (two requiring complete nephrectomy later)	4
Pelviolithotomy	6
Ureterolithotomy	3
Cutting of anomalous blood vessels to relieve hydronephrosis	1
Ligation of aberrant (upper) ureter opening into the vagina	1

The surgical treatment of pathological complications, other than lithiasis, which affect the double kidney will, in the majority of cases, be radical, necessitating nephrec-

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 7. (Case A277876.) Three separate pelves leading from a common ureter.

Fig. 8. (Case A299173.) Complete unilateral duplication; moderate hydronephrosis in the lower segment.

Fig. 9. (Case A308528.) The upper pelvis is injected with sodium bromide. The lower pelvis is filled with stones.

tomy. Although infection, particularly if it is chronic, may be largely confined to the primary segment, it usually will invade the other segment to such an extent that nephrectomy is advisable. Conservative operation is permissible only in the presence of lithiasis, early localized infection other than tuberculosis, or small hydronephrosis confined to one segment. Nephrolithotomy or pelviolithotomy offers no greater technical difficulties in the double kidney than in the normal. A small stone in the pelvis, however, may be easily overlooked unless the duplication is recognized. In one case in our series, ligation of an anomalous renal blood vessel which constricted one of the ureters was sufficient permanently to remove obstruction to urinary drainage. In the case in which an aberrant ureter ended in the vagina the secretion from one segment was markedly diminished. The ureter was ligated and the patient had no complications other than the usual reaction following ligation. This would suggest the possibility of treating hydronephrosis in the double kidney, when not too extensive or infected, by merely ligating the ureter of the affected segment.

Heminephrectomy. Resection of the diseased segment of a double kidney, on first thought, seems to be a formidable procedure. When conditions are favorable, however, it offers no great technical difficulties and is followed by favorable results. Owing to the fact that opportunities for the operation are limited and the anatomical conditions are often not recognized, heminephrectomy has seldom been performed in the past. If there is considerable pyelonephritis in the resected segment, infection often spreads to the remaining portion after heminephrectomy, the urine which may have been normal prior to the first operation becomes infected, and subsequent nephrectomy is necessary.

Heminephrectomy has been reported as successful by Albarran, Le Dentu, Lennander, Pawloff, Mayo, Rumpel, Young, and Herrick. Albarran reported a case of a double kidney on the left side in which there was a thin

isthmus of connecting tissue. The lower segment was normal; the upper segment was pyonephrotic and was successfully resected. Le Dentu resected an upper segment which contained a small dilated pelvis; although the lower segment appeared to be fibrous and showed chronic nephritis, it was allowed to remain. A fistula persisted for 4 months. Lennander resected a lower segment which he described as being pyonephrotic. Pawloff described the resection of one segment for hydronephrosis. Young resected an upper segment which was atrophic and contained a branched stone.

In two cases in this series (Cases 3 and 4) primary heminephrectomy was performed, but evidence of renal infection and persistence of symptoms made it necessary to perform a secondary nephrectomy; at the time of primary operation the remaining segment had appeared to be normal. In Case 3 the urine collected from the segment prior to operation was normal and the phenolsulphonephthalein excretion 8 per cent in 15 minutes. Heminephrectomy had been performed because of a small infected hydronephrosis and stone in the lower segment with apparently successful results. Within a few months, the patient had dull pain referred to the affected kidney and other evidences of renal infection. Seven months after operation, catheterization of the remaining segment showed marked renal infection; only a trace of phenolsulphonephthalein was returned in 15 minutes. Nephrectomy of the remaining segment was performed, and examination showed diffuse pyelonephritis with atrophy. It is evident that heminephrectomy should not be attempted unless the pathological condition is confined entirely to one segment and clinical evidence shows definitely that the remaining segment is normal and functioning. Even under such favorable circumstances infection may invade the remaining segment, necessitating a secondary operation. With proper suturing the postoperative hæmorrhage should be negligible. If infection remains in the tissues, however, a sinus may persist indefinitely and reopen at intervals. The healing process resulting after heminephrectomy was clearly shown in the segment of a double kidney which was subsequently removed. The resected surface, though pitted in some areas, was smooth, and had assumed the normal rounded contour of one of the renal poles. The pathological process had involved only the tissues immediately adjacent to the line of incision. There was moderate lymphocytic infiltration, in some areas, possibly caused by absorbed suture materials. The glomeruli were somewhat clumped and the destruction of interglomerular tissue was greater than that of glomeruli. There was only slight fibrosis and hyalinization of the glomeruli, and many immediately adjacent to the line of incision were apparently normal. Factors rendering operation easier and favorably influencing the results are (1) considerable distance separating the two pelves; (2) definite division of the two segments by a cicatricial band, and definite confinement of the disease to one segment, and (3) chronic and cicatricial nature of the pathological lesion.

Hydronephrosis. The most common lesion requiring surgical treatment is hydronephrosis caused, usually, by the obstruction of one ureter. Whether this occurs at the point where the ureters cross one another and is the result of this crossing, as suggested by Pawloff, has not been definitely proved. It seems probable, however, that in some cases the ureteral obstruction is the result of stricture due to congenital anatomical defect. In several of the cases herein reported, stricture in the lower ureter was associated with marked dilatation of the ureter above, comparatively little dilatation of the renal pelvis itself, and marked cicatricial pyelonephritis in the peripelvic renal tissue. In cases of large hydronephrosis, the surrounding tissues usually become involved and atrophied and the infection may spread to the other renal segment.

Tuberculosis. In six cases of Group 1 nephrectomy was performed for tuberculosis. In four the disease was largely confined to the lower segment. In each case a distinct cicatricial band separated the two segments, which evidently represented nature's determined effort to confine the disease to the segment in which it originated. If partial resection of the kidney for a localized area of tuberculosis could ever be considered, no more

favorable opportunity could be discovered. However, microscopic examination of every such kidney removed showed that isolated giant cells had invaded the apparently normal tissue adjacent to the area of tuberculosis.

Chronic tuberculosis confined to one pole of a single kidney, if caseated or fibrous and walled off from the remaining apparently normal renal tissue, may easily be confused with tuberculosis involving one segment of a double kidney. The pelvis of the diseased segment may be obliterated and the ureter be atrophied or involved in localized perirenal adhesions and thus difficult to identify. The original pelvic duplication of the kidney doubtless has been occasionally overlooked.

Atrophic pyelonephritis. The atrophic or cicatricial form of pyelonephritis is of comparatively common occurrence and may offer unusual difficulty in clinical diagnosis. Although the process may be confined largely to one segment, the other is often also involved so that in most cases nephrectomy is necessary. In the pyelogram the usual, small, abbreviated pelvis of the upper segment of a normal double kidney may be confused with the contracted pelvis usually observed in atrophic pyelonephritis in the single kidney. A differential phenolsulphonephthalein estimate should establish the diagnosis, since in atrophic pyelonephritis return of the dye is greatly reduced, varying from a trace to 1 or 2 per cent in 15 minutes; in a duplicated pelvis the return is generally at least 6 or 8 per cent.

HEMINEPHRECTOMY: FOUR CASES

CASE 1. (A308528.) Miss K. M., age 27, came to the Clinic because of frequent short attacks of pain on the right side. For the last 3 years, pain at times had become very severe, and discomfort had been almost constant. Appendectomy had been performed, but the character of the pain remained unchanged.

The physical examination was negative. The urine contained a few pus cells, and the two-hour return of phenolsulphonephthalein was normal. Roentgen-ray examination revealed a branched irregular shadow in the renal area. At cystoscopic examination the bladder, urine, and ureters were found to be normal. Phenolsulphonephthalein return in 15 minutes was 12 per cent from the left ureter and 5 per cent from the right. A pyelogram revealed a double pelvis on the right; the branched, irregular shadow was obscured in the lower pelvis. A diagnosis of a double right kidney with multiple stones in the lower pelvis was made.

At operation a moderately enlarged kidney was found with two pelves and two ureters which united 2 centimeters below the two pelves. The lower pelvis was small and contracted and contained several stones. The ureter of this portion was dilated and obstructed by a small stone which had lodged at the point of juncture with the upper ureter. The lower segment of the kidney, which was demarcated from the upper by a deep groove, was dissected free at the juncture of the middle and lower thirds. As each portion had a separate blood supply, the artery and vein to the lower portion were ligated and cut. The ureter was excised close to its juncture with the upper segment and removed with the lower segment of the kidney. The line of incision on the remaining renal segment was sutured and covered with a fatty fascial flap. The portion of the kidney removed contained a branched stone, several small stones, and several cortical abscesses with small stones. Postoperative recovery was rapid; several times a small sinus at the lowest angle of the incision drained a few drops of pus and then closed. Eighteen months later, the patient was perfectly well.

CASE 2. (A57428.) Mrs. M. C. T., age 32, came to the Clinic because of a general sense of discomfort in the right side of the abdomen of 7 years' duration. Four weeks before, abdominal discomfort had increased.

Physical examination was negative except for a palpable right kidney. Urinalysis and the roentgen-ray examinations were negative. Cystoscopic examination revealed complete duplication of the right ureter. Right pyelograms revealed a stricture of the inner ureter near the bladder wall with a hydro-ureter above. The pelvis connecting with this ureter was apparently not dilated; the lower pelvis and ureter were normal. A diagnosis was made of double kidney and ureter with a hydro-ureter draining the cephalad segment.

At operation a double right kidney was found with complete duplication of the ureter and pelvis. The ureter draining the upper pelvis was dilated to the size of the small intestine down to a strictured point near the bladder. Each half of the kidney had its own blood vessels. The ureter and blood vessels to the upper portion were ligated and the upper half of the kidney resected. The ureter was dissected to 2 centimeters above the bladder where it was ligated and cut. The remaining section of the kidney was sutured with catgut. The patient's recovery was uneventful and, 1 year later, she was much improved, although she had pain occasionally in the right side.

CASE 3. (A59781.) Mr. H. S. H., age 45, came to the Clinic with attacks of pyuria associated with chills and fever. Seven years before, he had had a short spell of hæmaturia and had passed a small stone. For the last 3 years, he had had intermittent attacks of left abdominal pain.

Physical examination revealed tenderness in the left loin. The urine contained pus and blood. The

roentgenogram contained a shadow in the left renal area. Cystoscopic examination revealed two adjacent ureteral openings on each side near the usual site in the trigone. On the left side the upper opening was dilated and exuded cloudy fluid; the urine from the lower was normal. A roentgenogram taken after the insertion of four lead catheters showed complete bilateral duplication; the pyelogram taken on the right side showed that the upper and lower pelves were connected by a common calyx. A left pyelogram made through the infected ureter revealed a dilated pelvis which accounted for the shadow in this area. The diagnosis was complete bilateral duplication of the ureters and pelves with calculous pyonephrosis in the lower segment of the left kidney.

At operation a double kidney with two ureters and two pelves was found; the lower pelvis was dilated and soft; it contained a stone and a small papilloma, probably a result of irritation. There was a definite line of demarcation between the two portions of the kidney; both segments had a separate blood supply. The ureter and blood vessels to the lower half were tied and cut and the lower portion of the kidney was resected. The patient recovered from the operation rapidly.

Seven months after the first operation, the patient returned complaining of almost constant pain in the region of the left kidney. The function from the right side was normal; that from the left, very slight. At a second operation the remaining portion of the kidney was removed. This portion of the kidney was apparently normal, except for moderate thickening and fibrosis of the renal pelvis. The area from which the pelvis had been removed at the previous operation was smooth, well healed, and without adhesions. Eleven years later, the patient had no trouble attributable to his renal condition.

CASE 4. (A232830.) Mrs. B. S. P., age 41, came to the Clinic because of hydronephrosis. Two years before, she had had an attack of hæmaturia of 2 weeks' duration. Since then she had had several attacks of fever, chills, and pain in the left kidney area, associated with frequency.

The physical examination was negative. The urine contained pus cells but no bacilli of tuberculosis. The roentgenogram showed multiple shadows in the left renal area. On cystoscopic examination bilateral ureteral duplication was found; two ureters opened on the right of the trigone and two on the left. The phenolsulphonephthalein return from the left upper ureter was 10 per cent in 15 minutes; from the lower, zero. A pyelogram after injection of both of the left ureters revealed complete duplication of pelvis and ureter; the multiple shadows seen in the roentgenogram of the kidney were confined to the lower pelvis. The diagnosis was complete bilateral duplication with hydronephrosis and stones in the lower left renal segment.

At operation a double left kidney was found; the lower portion consisted of a hydronephrotic sac 12 centimeters in diameter containing several stones. The hydronephrosis was caused apparently by kinking of the ureter by an anomalous blood vessel; the stones were secondary to the dilatation and infection. The sac was dissected out and the lower part of the kidney amputated; the upper two-fifths with the small pelvis and ureter were left intact. The cut surface was sutured with catgut. Following the operation the patient had a constantly high temperature and the wound drained freely. One month later, the wound was reopened and the remaining portion of the kidney was removed; it contained a moderate amount of normal tissue, but gave evidence of chronic infectious nephritis. The patient improved rapidly and, 3 years later, was in good health.

NEPHRECTOMY FOR HYDRONEPHROSIS: SIX CASES

CASE 5. (A81801.) M. D., a baby girl, age 9 months, was brought to the Clinic on account of abdominal cramps and fever of 4 weeks' duration. The baby looked septic and on examination a movable tender mass was found in the left side of the abdomen. On exploration the left kidney was found to be about twice the size of a normal adult kidney; double ureters were fused just above the bladder at a point where distinct narrowing was made out. The common ureter was divided above the bladder and removed with the renal mass. The kidney was composed of two greatly dilated and thickened pelves separated from one another by a thin layer of renal tissue; the minor calices were obliterated. There was almost complete obliteration of the renal tissue (Fig. 10, frontispiece). One year later, the child was in excellent health.

CASE 6. (A151528.) Mrs. B. C., age 52, came to the Clinic complaining that she had been feeling weak and run down since her last confinement, 16 years before. For the last 4 months, she had had a dull pain in her back and frequency of micturition.

The urine contained pus cells. The roentgenogram contained a small shadow in the region of the left kidney. On cystoscopic examination, an impassable obstruction was found in the left ureter 20 centimeters from the bladder. The urine from the left side contained pus; from the right the urine was normal. The phenolsulphonephthalein return from the left kidney was 1 per cent in 15 minutes. A diagnosis of left pyonephrosis was made.

At operation a double kidney was removed. Both pelves were dilated. The ureters connecting the two pelves united 3 centimeters below. They were almost completely obstructed at the juncture by a small stone which accounted for the shadow seen in the original roentgenogram. There was only moderate destruction of the renal parenchyma. The upper segment was smaller than the lower and its pelvis was markedly dilated and thickened; the lower pelvis was only slightly increased in size but showed moderate fibrosis. The patient's convalescence was uneventful, and 2 months later, she was in good health.

CASE 7. (A103071.) Mrs. C. D., age 34, came to the Clinic complaining of attacks of right abdominal

colic associated with chills, fever, and pyuria, beginning 8 years before, after childbirth, and lasting about 2 years. During the last 6 years pain had been intermittent in the upper right abdominal quadrant. Her gall bladder had been explored, but it had been found normal.

On physical examination a tender mass was palpated in the upper right quadrant. The roentgenogram and examination of the urine were negative. Cystoscopic examination revealed a normal bladder with normal appearing urine from both sides. The phenolsulphonephthalein return was 12.5 per cent from the left ureter in 15 minutes and 7.5 per cent from the right. A pyelogram of the right kidney revealed duplication of the pelvis and ureter with hydronephrosis and hydro-ureter. A diagnosis of right hydronephrosis in a double kidney was made.

At operation the right kidney was removed. A double pelvis and ureter were found; the upper ureter was markedly dilated. Both ureters were excised about 8 centimeters from the kidney, but the point of bifurcation was not found. The upper part of the kidney was almost completely destroyed, the lower contained little normal tissue and much interstitial fibrosis. The patient recovered from the operation readily.

CASE 8. (A234432.) Mr. R. R. P., age 46, came to the Clinic because of intermittent periods of hæmaturia of 5 years' duration. For several months, he had had moderate pain in his left knee and ankle and a sense of discomfort in the region of the right kidney.

The physical examination was negative; the urine contained pus cells and blood. A roentgenogram contained multiple shadows in the right kidney area. Cystoscopic examination revealed a normal bladder. The urine from the right ureter contained a small amount of pus; that from the left was normal. The phenolsulphonephthalein return was 10 per cent from the right ureter in 15 minutes, and 12 per cent from the left. A pyelogram of the right kidney revealed duplication of the pelvis and ureter; the calices of the lower pelvis were dilated, which obscured the shadows seen in the original roentgenogram. A diagnosis of stones in a right double kidney was made.

At operation a double kidney almost completely divided by a lateral sulcus was found. The ureters draining the two pelves united about 3 centimeters below the lower pelvis. A small papillary cystadenoma was enucleated from the renal cortex and two small stones were removed from the lower pelvis.

Six months later, the patient returned to the Clinic. He had gained 15 pounds and had no urinary complaint, but he had a constant dull pain in his lower right quadrant. The roentgenogram contained a shadow in the region of the right kidney. Cystoscopy and pyelography located the stone in the lower pelvis. Both the upper and lower pelves showed moderate inflammatory dilatation.

At the second operation the right kidney was removed. Both pelves contained evidences of chronic infection and the lower ureter was dilated and thickened. Many fine cortical abscesses were scattered throughout both portions of the kidney (Fig. 11). Three years later, the patient was perfectly well although at times he had slight pain in the lower abdomen.

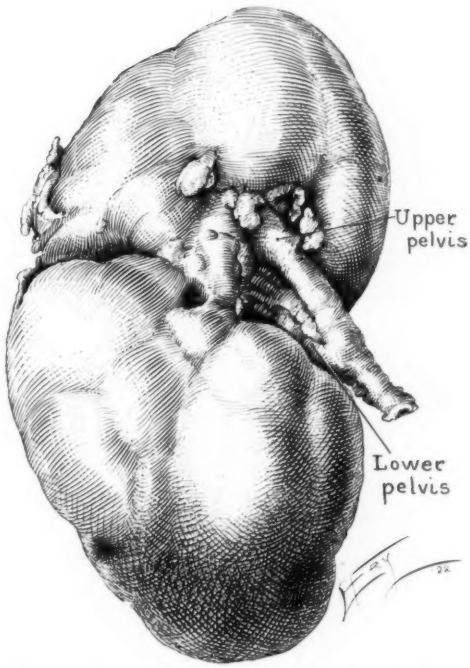

Fig. 11. (Case 8-A234432.) Double kidney with dilated infected lower segment, containing many cortical abscesses. The upper and lower segments are separated from one another by a deep cleft.

CASE 9. (A308206.) Mr. A. K., age 45, came to the Clinic on account of numerous attacks of left renal colic and almost constant dull heavy pain in the left lower abdomen during the last seven years.

The general examination was negative. The urine contained a moderate amount of pus and red blood cells. The roentgenogram contained a shadow opposite the third lumbar vertebra. At cystoscopic examination clear spurts of urine were seen coming from both ureters. The differential functional test was 15 per cent return of the dye from the right side and 7 per cent from the left. A left pyelogram revealed a dilated ureter and a large hydronephrosis, which obscured the shadow opposite the third lumbar vertebra. A diagnosis of left hydronephrosis with stone was made.

At operation a large kidney with two moderately dilated pelves was found on the left; the upper and larger was drained by a greatly distended ureter. Both left ureters opened into a markedly sacculated pouch, which extended from the juncture 3 centi-

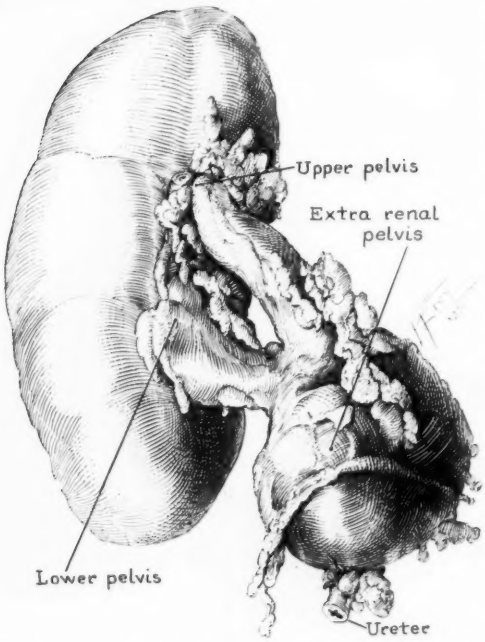

Fig. 12. (Case 9-A308206.) Primary division of the ureter or pelvis situated away from the kidney and attached to it by elongated ureteral divisions. Each division drains a separate renal segment.

meters below the upper pelvis toward the bladder for a distance of 7 centimeters. A small stone was found impacted in the lower end of the sacculation, blocking the common outlet (Figs. 12 and 13). Two years later, the patient was in good health having had no further trouble.

CASE 10. (A376487.) Miss M. J., age 32, came to the Clinic because of attacks of dull pain referred to the left abdominal quadrant and radiating to the lower quadrant; she had had attacks for 4 years, a severe one a year and a half before. Recently, the attacks had occurred every 8 to 10 days, or they lasted from 12 to 24 hours and were followed by a dull ache in the anterior part of the abdomen, often with flatulence and distress over the entire lower abdomen. Frequency was moderate. It will be noted that the pain was entirely anterior and not at all suggestive of renal involvement.

The urinalysis was practically negative. The phenolsulphonephthalein return was 50 per cent in 2 hours and 15 minutes. Roentgenograms of the urinary tract, colon, and stomach were negative. A cystoscopic examination was made for the purpose of identifying the pain. Both ureteral orifices were normal in location and appearance, and secretion of the right kidney was normal. A catheter introduced into the left ureter did not meet obstruction. One hundred ten cubic centimeters of residual urine was withdrawn from the renal pelvis, and there was only a faint trace of phenolsulphonephthalein in 15 minutes. A pyelogram of the left kidney showed definite dilatation of pelvis and calices. The dilatation, however, did not appear sufficiently marked to account for the large amount of residual urine found in the renal pelvis, which we were at a loss to explain. A diagnosis of left hydronephrosis was evident.

At operation the renal pelvis was found to be markedly dilated. The kidney tissue was evidently largely destroyed, and a nephrectomy was performed. On section of the kidney two definite segments of the renal pelvis were found, the upper of which was confined within the kidney proper; the dilated portion visible outside the kidney was directly related to the lower segment only. The two segments of the pelvis were separated by a definite band of atrophied renal tissue and were connected by a narrow isthmus which corresponded to two adjacent calices which had coalesced. The calices were markedly dilated in both pelves. Only a narrow rim of cortical tissue remained which appeared to be atrophic. The patient had a normal convalescence and two months later was in good health.

NEPHRECTOMY FOR TUBERCULOSIS: SIX CASES

CASE 11. (A81845.) Mr. R. F. R., age 37, came to the Clinic because of frequency, dysuria, and occasional attacks of moderate pain in the left renal area for the last 2 years. He had had both testicles removed for tuberculosis 7 years before.

The left abdominal wall was rigid. The roentgenogram was negative. The urine contained pus cells and bacilli of tuberculosis. Cystoscopic examination revealed only slight cystitis. Normal urine was obtained from the right ureter; the opening of the left would not admit a catheter; the site was marked by a small area of granulation. A diagnosis of occluded left renal tuberculosis was made.

At operation a double kidney about twice the normal size was removed. There were two pelves and two ureters; both ureters were dilated and thickened. There was a well-defined sulcus dividing the upper portion of the kidney from the lower. Bifurcation of the ureters was not found. The lower kidney and pelvis composed only about one-fourth of the entire mass. The pelvis was thickened and contracted and the surrounding renal tissue was almost completely destroyed by an extensive tuberculous caseation. A band of solid renal tissue 3 centimeters wide separated the two pelves. The upper pelvis was slightly dilated; the cortex of this portion contained a few small areas of tuberculosis. Six months later, the patient was in good health.

CASE 12. (A219577.) Mrs. H. B., age 25 years, came to the Clinic complaining of a dull ache in her back of 2 years' duration. Two weeks before, she had noticed blood in the urine; this had been in-

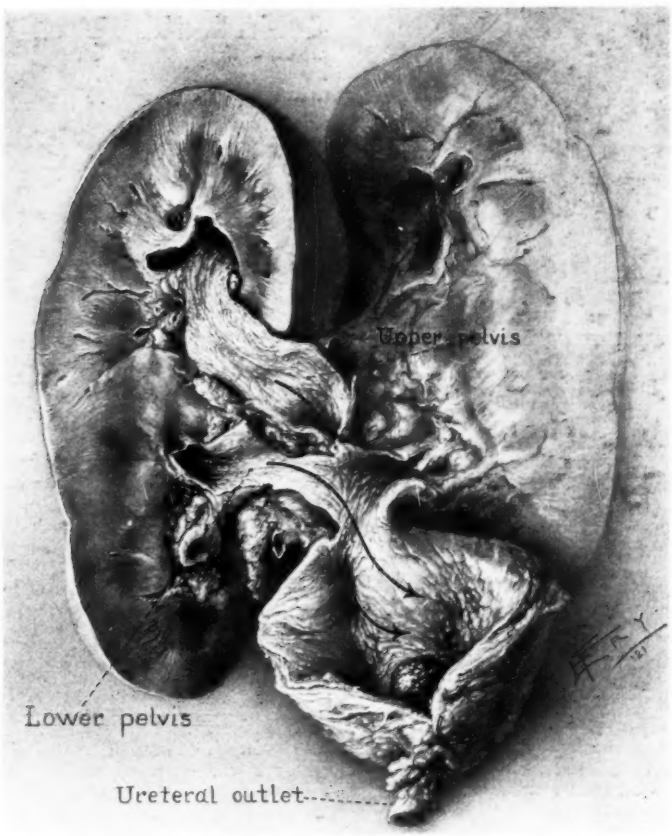

Fig. 13. (Case 9-A308206.) Section of double kidney showing extrarenal pelvis blocked at its outlet by a stone.

creasing. Several days after the onset of the bleeding she had developed a severe cramp-like pain in the region of the left kidney.

At examination the left side of the abdomen was found to be tender; the glands in the cervical region were enlarged. The urine contained both pus and blood but no bacilli of tuberculosis. The roentgenogram showed several small shadows in the region of the left kidney. Cystoscopic examination revealed a normal bladder. The urine from the left ureter contained blood; that from the right was normal. The phenolsulphonephthalein return was 12 per cent from the right ureter in 15 minutes and 10 per cent from the left. A left pyelogram revealed duplication of the pelvis; the shadows observed in the original roentgenogram were included in the lower pelvis where there was also evidence of tissue necrosis. A diagnosis of left double kidney with infection and stones in the lower pelvis was made.

A left nephrectomy was performed. The two pelves of a double kidney were found to be separated from one another by a heavy band of renal tissue; a deep groove externally marked the division. The lower pelvis was small and contracted and showed extensive tuberculous caseation; a thickened œdematous ureter drained it. The shadows seen in the roentgenogram and thought to be stones were caused by calcareous deposits in the centers of these areas of tuberculous caseation. The upper, smaller, and apparently normal portion of the kidney emptied into the lower portion through a narrow, tapering connection. The patient recovered from the operation and is now well.

CASE 13. (A299002.) Mr. C. A. T., age 33, came to the Clinic because of indefinite pain in the lower abdomen of 2 years' duration. Appendectomy had been performed without relief. During the last year he had had moderate pain in the left loin, especially

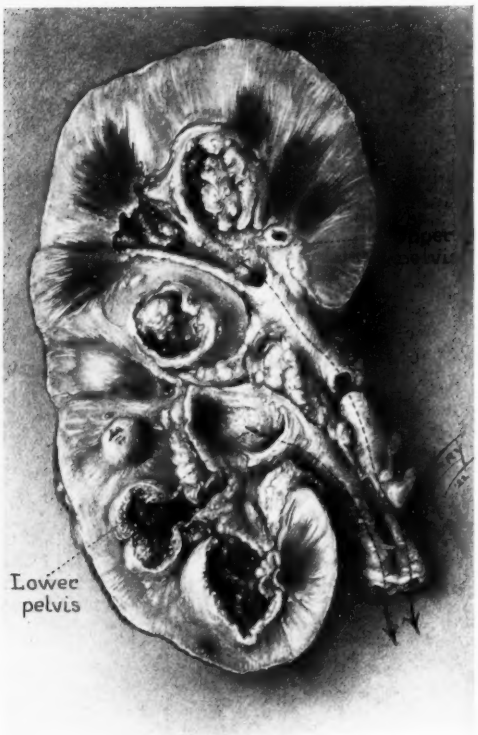

Fig. 14. (Case 13-A299002.) Extensive caseating tuberculosis involving both segments of a double kidney.

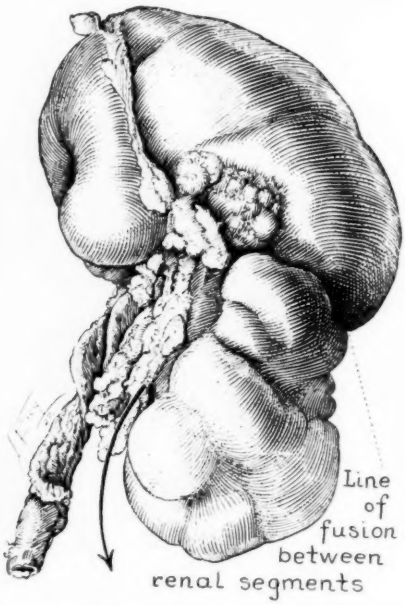

Fig. 15. (Case 16-A377195.) Extensive tuberculosis of the lower segment of a double kidney. The two segments are almost completely separated from one another. The upper segment contains a few scattered tubercles and giant cells.

noticeable after exertion or when riding horseback. He had not had urinary symptoms, although for several months there had been pus in the urine. Ten days before, while riding horseback, he had bruised his left testicle.

The physical examination was negative except for the finding of an enlarged nodular urine-stained epididymis. The urine contained a large amount of pus and bacilli of tuberculosis. Cystoscopic examination revealed a moderate degree of cystitis; clear urine was obtained from the right ureter and cloudy from the left. The phenolsulphonephthalein return was 22 per cent from the right ureter in 15 minutes and 2 per cent from the left. A pyelogram of the left kidney revealed a few scattered areas of dilated calices and evidence of tissue necrosis. A diagnosis of left renal tuberculosis was made.

At operation a kidney twice the normal size was removed. Two thickened dilated ureters drained separate pelves and joined each other about 2 centimeters below the lower pelvis. On section extensive caseating tuberculosis of both sections of the kidney was found. The pelves were of about equal size and were divided by a band of parenchymatous tissue 1 centimeter wide (Fig. 14). Three weeks later, the left epididymis was removed and found to be tuberculous. The patient's convalescence was uneventful and he left the hospital in good condition.

CASE 14. (A339574.) Mrs. H. E. C., age 50, came to the Clinic because of frequency and dysuria and occasional lower abdominal pain, of 3 years' duration.

The physical examination was negative. The urine contained a moderate amount of pus and bacilli of tuberculosis. Roentgenogram of the kidneys showed a few calcified flakes in the right renal area. On cystoscopic examination ureteral cystitis of moderate degree was found. The inner of the two ureteral openings on the left side was apparently normal; the upper was contracted and eroded and emitted only an occasional spurt of turbid urine. The ureter and kidney on the right were both normal. On catheterization of the two left ureters a stricture was encountered in the outer ureter 10 centimeters from the opening. The phenolsulphonephthalein return was 6 per cent from the inner ureter in 15 minutes and 1 per cent from the outer. Pyelograms of the left kidney revealed a double pelvis, the upper connected with the lower. The lower pelvis injected through the outer catheter pos-

sessed only a few dilated calices and a distended ureter. A diagnosis of duplication of the left kidney with tuberculosis of the lower segment was made.

At operation a long, thin, tapering kidney with a definite line of division on the anterior surface was removed. There were two pelves and two ureters. The segment between the two pelves showed extensive tuberculous caseation which extended to, and almost completely destroyed, the lower pelvis. The upper renal segment was normal in appearance but a histological examination revealed few isolated tubercles in the renal cortex. The patient convalesced normally and, 2 years later, was perfectly well.

CASE 15. (A342668.) Mrs. B. M., age 30, came to the Clinic with urinary frequency at intervals, which had begun 11 years before, and pain referred to the neck of the bladder. For 2 years, the patient had had occasional dull pain referred to the left kidney area, but this had improved during the past year. She had had occasional spells of epigastric distress. The general condition was suggestive of neurosis. There was no loss in weight.

General physical examination, including roentgenograms of the urinary tract and chest, was negative. A specimen of urine catheterized from the bladder contained only 20 pus cells in a high-power field of the microscope. The sediment was stained for the bacilli of tuberculosis and was negative. The phenolsulphonephthalein return was 50 per cent in 2 hours and 15 minutes. Cystoscopic examination revealed a bladder with normal capacity, and save for a few areas of slight inflammation, comparatively normal. The left ureteral opening was slightly eroded, with an inflamed area of mucosa and granulation tissue around it. Obstruction was met by the catheter introduced into the left ureter at a distance of 2 centimeters from the opening, but at a subsequent examination the catheter passed into the ureter to a normal length without obstruction. Catheterized specimens obtained at the second examination from both right and left kidneys were normal. A pyelogram made of the left side showed a very small pelvis with abbreviated calices. The ureter was but slightly dilated for a distance of several centimeters. Below this it was markedly dilated. A diagnosis was made of duplication of the pelvis and ureter with destruction of the lower pelvis (?), atrophic pyelonephritis (?), and tuberculosis of the left kidney (?).

At operation a double kidney with duplication of the pelvis and ureter was apparent. The lower pole of the kidney was atrophic and cicatricial. The two parts of the kidney seemed quite distinct, with a definite zone of demarcation. It was thought at first that the lower portion was atrophic as the result of cicatricial pyelonephritis, since no definite evidence of tuberculosis had so far been discovered. The lower portion was then resected without much difficulty. On microscopic section of the renal tissue at the line of excision, areas were found containing atypical tubercles and giant cells. The remaining portion of the kidney was then removed. The patient had an uneventful convalescence and left the hospital in good condition.

CASE 16. (A377195.) Mr. G. V. G., age 35, came to the Clinic with symptoms beginning 15 years before with slight urinary frequency at irregular intervals. Seven years before, he had had a period of dysuria with increased frequency and very cloudy urine which had continued over a period of several months. Since then he had had diminished urinary disturbance with soreness and dull ache in the urethra. Five years before, he had noticed hard painless nodules in the left epididymis, and 2 years before the same condition in the right epididymis. One year before, he had had slight hæmaturia.

The general examination was negative save for moderate chronic bilateral tuberculous epididymitis. The left lobe of the prostate was nodular. Roentgenograms of the urinary tract and chest were negative. A moderate amount of pus was found in the urine, and, after repeated stains, acid-fast bacilli were found. The phenolsulphonephthalein return was 50 per cent in two hours. Cystoscopic examination revealed a slight cystitis. The urine from both ureters appeared to be normal. A catheterized specimen of urine from the right kidney was normal; that from the left contained an occasional pus cell. The differential phenolsulphonephthalein test showed 20 per cent to be coming from the left kidney, and 7 per cent from the right in 15 minutes. A pyelogram of the left side showed marked dilatation of the ureter; the pelvis and calices were abnormally small. A diagnosis was made of tuberculosis of the left kidney.

At operation a double kidney with tuberculosis in the lower segment was found. The upper portion of the kidney appeared to be normal, while the lower segment was very evidently diseased and functionless (Fig. 15). Since the bacilli of tuberculosis had been found in the urine, a complete nephrectomy was performed. On section of the kidney a sharp line of demarcation between the healthy and diseased portions was noted. On microscopic examination of the apparently normal tissues, however, several areas of encroaching foci of tuberculosis were observed. The patient had a normal convalescence and left the hospital in good condition.

NEPHRECTOMY FOR ATROPHIC PYELONEPHRITIS: THREE CASES

CASE 17. (A188815.) Mr. H. K. E., age 26, came to the Clinic because of pain in the left renal area of 16 years' duration. The pain had been most noticeable during micturition. During the last 3 years, he had had several attacks of left renal colic accompanied by frequency and pyuria.

Physical examination was negative except for the finding of tenderness in the upper left quadrant of the abdomen. The urine contained pus cells and blood; the roentgenogram was negative. Cystoscopic examination revealed diffuse cystitis with pus cells and blood coming from the left ureteral opening.

The phenolsulphonephthalein return was 20 per cent from the right ureter in 15 minutes and 5 per cent from the left. A left pyelogram revealed inflammatory changes of the renal pelvis. A diagnosis of chronic pyelonephritis with atrophy was made.

At operation a small contracted kidney was removed. Two calices and two ureters were present; both ureters were markedly thickened. The kidney was divided by a deep sulcus into two distinct parts. The upper portion was almost completely destroyed; the surfaces of the dilated calices and pelves were necrosed. The pelvis of the lower half was thickened and contracted and the renal tissue had been replaced almost completely by fat and fibrous tissue. Atrophy of all the renal tissue was practically complete. The patient made a rapid recovery after operation and, one year later, was perfectly well.

CASE 18. (A223011.) Mrs. T. L. M., age 47, came to the Clinic complaining of attacks of urinary frequency of 5 years' duration. Occasionally she had felt dull pain in the region of the left kidney. Three years before, she had been told that the left kidney was infected; the left renal pelvis had been lavaged a number of times.

The physical examination was negative except for the finding of infected tonsils. The urine contained a small amount of pus and blood. On cystoscopic examination a mild cystitis was found; the urine from the right ureter was normal, that from the left contained pus cells. The phenolsulphonephthalein return was 25 per cent from the right ureter in 15 minutes and 1 per cent from the left. A pyelogram of the left kidney revealed a small contracted pelvis. A diagnosis of left atrophic pyelonephritis was made.

At operation a contracted septic kidney about one-half normal size, with two ureters, was removed. A line of division indented the anterior surface of the kidney between the upper and lower portions. Two distinct pelves, thickened and contracted, were separated by a division of fibrous renal tissue. The renal tissue in the lower segment was almost completely destroyed by fibrosis. The patient made a prompt recovery after the operation and was well 4 years later.

CASE 19. (A308248.) Mrs. C. I. W., age 30, came to the Clinic because of frequency and dysuria. For 6 months, she had been feeling listless and run down. For 6 weeks, she had had severe pain in the left lumbar region radiating to the left groin with spells of frequency and dysuria and, on several occasions, chills and fever.

At physical examination an area in the left lumbar region was found to be tender. The temperature was 102°. The urine contained a large amount of pus and the phenolsulphonephthalein return was normal. The roentgenogram contained an indefinite shadow in the area of the left kidney. At cystoscopic examination clear urine was seen coming from both sides. Phenolsulphonephthalein return in 15 minutes was 17 per cent from the right ureter and 4 per cent from the left. A pyelogram of the left kidney revealed a small contracted pelvis. On account of the high temperature and tenderness over the left kidney a diagnosis of septic left kidney with atrophy was made.

At operation a kidney, normal in size, with two pelves and ureters was removed. The lower half of the kidney was studded with many small cortical abscesses. The pelvis draining this portion was dilated and almost completely filled with fat, which would account for the contracted appearance of the pyelogram. A slight sulcus on the anterior surface of the kidney divided the two portions. The ureteral juncture was not seen. The patient recovered readily from the operation and, 20 months later, was perfectly well.

SUMMARY

One hundred forty-four patients with duplication of the renal pelvis and ureter have been observed at the Mayo Clinic. The incidence of aberrant and bilateral duplications of ureters and pelves reported in the literature is relatively too high owing to the tendency to report the more unusual cases. Of the patients in this series the duplication was unilateral in 135 (94 per cent) and bilateral in 9 (6 per cent). Of the 135 patients with unilateral duplication 36 (25 per cent) had complete duplication and 99 (68.7 per cent) had incomplete duplication. Of the 9 patients with bilateral duplications 8 had complete duplication and 1 had incomplete.

Duplication may vary from duplication confined to the renal pelvis to duplicate pelves with separate ureters opening into the bladder. The pelves are generally unequal in size, the upper being the smaller, and are separated by a bridge of normal renal cortex of variable extent. When an unusually small renal pelvis is outlined in the pyelogram, the possibility of duplication should be suspected.

Complete duplication will be discovered more often if a careful search is routinely made for anomaly at the time of cystoscopic inspection. In cases of partial duplication the diagnosis is made only by means of a pyelo-ureterogram.

The lower segment is primarily involved more often than the upper.

Hydronephrosis is the most common pathological complication and is due to ureteral obstruction, generally in the region of the juncture of the two ureters in cases of incomplete duplication.

In tuberculosis of double kidneys gross evidence of the disease is generally confined to one segment, usually the lower; but in all cases histological examination reveals tubercles in the intervening renal tissue and extending into the remaining segment.

Occasionally when only one pelvis is outlined by the pyelogram, its unusual shape and contour may be misconstrued with pathological changes occurring in single kidneys, such as atrophic pyelonephritis.

In the series of 144 cases, the histories of 19 of which are here reported, 30 patients were treated surgically, 24 patients had definite pathological conditions which did not require surgical treatment, and in 27 evidence of disease was doubtful. Only 61 (42 per cent) of the patients were without pathological complications and the anomaly was discovered in the examination for other conditions.

Fifteen of the 30 patients operated on submitted to primary nephrectomies and 4 to heminephrectomies; 2 of these later required complete nephrectomy. Six pyelolithotomies and three ureterolithotomies were performed. In one patient hydronephrosis was relieved by the cutting of an aberrant vessel and in another symptoms were relieved by the ligation of an aberrant ureter from the upper pole of a double kidney.

In the treatment of pathological complications in a double kidney the indication for heminephrectomy is limited to but a few favorable cases. The possibility of infection extending to the remaining half of the resected kidney, which may necessitate subsequent complete nephrectomy, must be considered.

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INFECTION OF THE SIGMOID AND LATERAL SINUS

Report of a Series of Nineteen Cases[1]

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Extension of infection from the middle ear and mastoid process to the sigmoid and lateral sinus is always to be dreaded. Although a certain percentage of patients thus affected recover, the majority will succumb if left to their own defensive mechanism. If timely operative interference is instituted, the prognosis is relatively good. The recorded experience of previous observers has been helpful in the care of such patients, and I am reporting these 19 cases for the purpose of adding our clinical experience to the data on the subject.

The 19 patients were observed at the Mayo Clinic during the past 5 years in a series of more than 500 cases of mastoid disease in which operation was performed and more than 150,000 miscellaneous cases examined in the ear, nose, and throat section. The patients have been divided for discussion into four groups:

Group 1. Patients with involvement of the sigmoid sinus by phlebitis, or non-obliterating thrombosis;

Group 2. Patients with obliterating thrombosis;

Group 3. Patients who died without submitting to operation;

Group 4. Patients who died and in whom the disease was not recognized clinically.

GROUP I

Case 1. (A215641.) C. S., a boy, age 11, was examined December 2, 1917, because of pain in the left ear and severe illness. He had had earache and discharge at the age of 1½ years, and since then occasionally earache without discharge. The present trouble began 2 weeks before with earache on the left, followed in a few days by spontaneous rupture with thick discharge and some pain. He had had fever but there was no history of chills. He had vomited three times, and was very weak. No treatment had been given except "fever medicine" and cold applications.

The boy appeared very ill, pasty, and apathetic. His temperature was 102°. The tonsils and adenoids were enlarged and infected. A rhinitis was resolving. Knee jerks were present. The left cervical glands were large and tender. The right ear appeared normal; the left vestibule was eroded by purulent discharge from the canal. Pulsation and drooping were marked. The mastoid was not especially tender on deep pressure nor was there pain on motion of the auricle. Hearing test revealed combined deafness. The boy could hear a conversational voice on the left. The leucocyte count ranged from 28,000 to 31,000. A subacute nephritis was found. Diagnosis was made of perisinus abscess with sinus involvement.

December 2, a complete mastoidectomy (complete exenteration of the mastoid cells) was performed on the left side with ablation of the sigmoid sinus. The degree of sclerosis encountered was unusual for so young a patient; bleeding was severe. The mastoid was of the small-cell variety in which the sigmoid sinus lay well back and very deep. The bone over the sinus appeared healthy, but on exposure of the sinus pus welled up. When the sinus was uncovered extensively from the bulb, more evidence of the disease was found. Both ends of the sinus bled freely after probing. A small epidural abscess over the tegmen was opened. The child was in fair condition when he left the operating room (Fig. 1).

Case 2. (A221818.) L. G., a girl, age 9, was examined February 11, 1918. Following influenza both ears had ruptured spontaneously and discharged for 4 weeks. The right ear, with a swelling behind it, had been the more painful. There was no history of chills, but each afternoon the patient had had fever. The "pasty look" had appeared within the last week.

The patient had the facies of sepsis and appeared ill. The tonsils were enlarged and red. There was a definite cervical adenitis. The right mastoid region was swollen; redness, fluctuation, and tenderness were more marked over the tip and emissary vein. The canal wall drooped definitely. One discrete gland over the left mastoid was noted. The membrane was full, the discharge thick. Perforation had occurred in the posterior inferior quadrant. The urine contained casts and blood cells. The leucocyte count was 14,800. A diagnosis was made of suppurative otitis media, with mastoiditis and sinus involvement.

February 12, a subperiosteal abscess was opened. The mastoid cells were filled with infected granulation and pus. The knee of the sinus was covered with granulation; the wall, which felt board-like, was opened and a mural clot encountered. The sinus was ablated (Fig. 2).

Case 3. (A229133.) Mr. L. M., age 18, came to the Clinic April 22, 1918, because of discharge from

[1] Presented before the Eye, Ear, Nose and Throat Society, Kansas City, February, 1922.

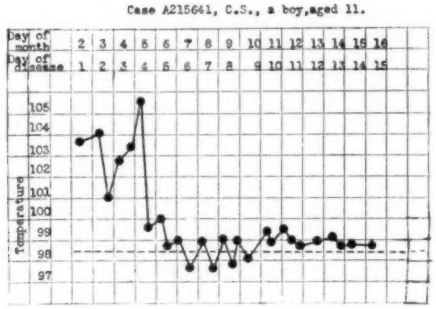

Fig. 1. Case 1. Postoperative course: Fourth day: Temperature of 105° probably represents a bacterial shower into the blood stream, as the wound was dressed at the time. It was not deemed necessary to interfere surgically unless the fever returned. The subsequent course was uneventful. The nephritic condition cleared up gradually. The patient was seen 3 years later because of an infected salivary gland.

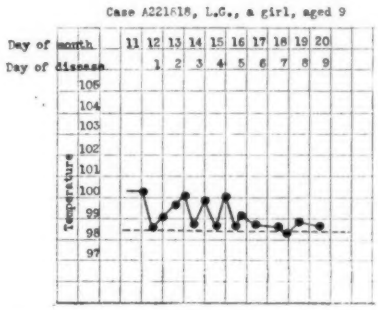

Fig. 2. Case 2. Postoperative course uneventful.

the right ear associated with pain and severe illness. Ten years before, following scarlet fever, the patient had had suppurative otitis media of both ears, which had subsided after 2 or 3 months. Two weeks before, pain had begun in the right ear following influenza. After 1 week, paracentesis had been performed by the home physician. The patient had felt better but the pain had continued, and he had had definite chills during the night. The temperature rose to 104°. The patient had been dizzy; once in attempting to rise he had fallen over backward, probably in a fainting spell.

The patient's facies were typically septic. There was extreme tenderness, slight œdema, and some redness over the right mastoid region. There was a moderate amount of pus in the sulcus and the superior canal wall drooped definitely. The temperature was 104°. Kernig's sign was questionable. On motion of the head, definite tenderness but no rigidity was noted. The leucocytes numbered 16,000. A diagnosis was made of suppurative otitis media with mastoiditis and thrombosis of the lateral sinus.

April 22 at operation, the cortex was found to be eburnated, the mastoid large, and of the small-cell variety; all the cells were bleeding and filled with granulation. The condition was quite typical of streptococcal infection. The wall of the sigmoid sinus appeared to be in good condition, but when the sinus was uncovered the wall was found to be covered with adhesions. On probing, there was good bleeding from above and below. Complete right mastoidectomy with ablation of the sigmoid sinus was performed. The blood culture was positive for streptococcus viridans. Seven days later, the jugular vein was ligated (Fig. 3).

Case 4. (A238280.) Miss T. T., age 18, came to the Clinic July 11, 1918, because of discharge from the right ear of 9 years' duration. She had had a mastoid operation 5 years before, but the discharge had continued. She seldom had pain and only occasional vertigo. Douching the ear did not make her dizzy.

Examination of the nose, throat, and left ear was negative. An old healed mastoid scar was seen on the right. The canal was filled with foul-smelling, purulent discharge. There was no membrane; the promontory was covered with red granulation, and a definite tract extended into the mastoid antrum from which caseous material was removed. The end organ was intact. The patient was observed for several days in the out-patient service. Local measures seemed to have little beneficial effect. A radical mastoid operation was considered.

July 29 at operation, the sigmoid sinus showed through the outer table clearly. The mastoid antrum and middle ear were approached after the method of Stache. It was necessary to uncover the sinus in order to remove the disease process in Trautmann's triangle. The sinus wall appeared unusually dark and dry. Because of the sinus exposure the packing was not done in the usual manner through the canal (Fig. 4).

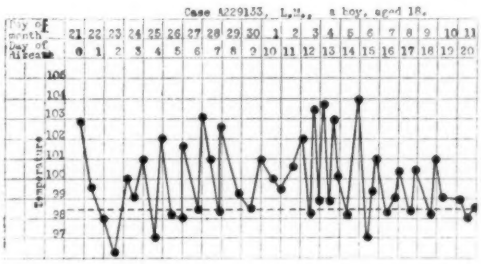

Fig. 3. Case 3. Postoperative course: First day: Much improved. Fourth day: Temperature 102°; leucocytes 23,200. Sixth day: Temperature 103° and chills, sinus wall pulsating at dressing. Eighth day: internal jugular ligation and sinus ablation. Sixteenth day: little improvement, although the blood culture became negative the leucocyte count remained about the same. Seventeenth day: blood transfusion 500 cubic centimeters, citrate method. From then on the convalescence was rapid.

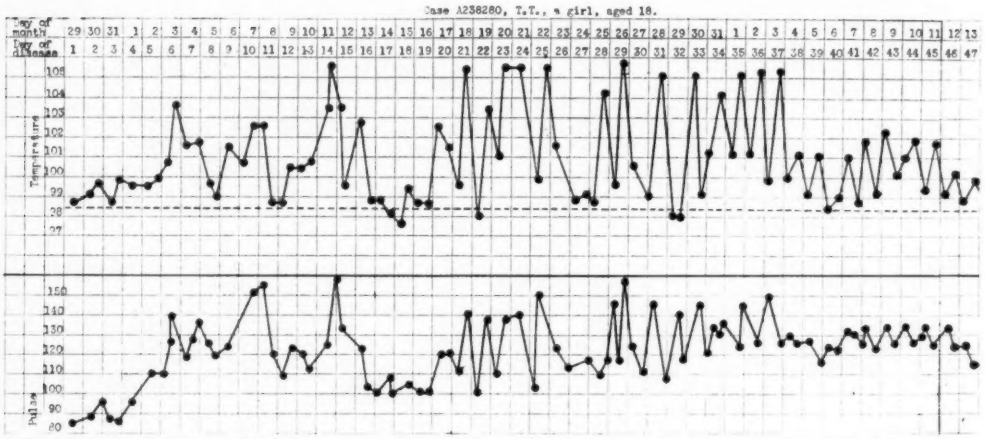

Fig. 4. Case 4. Postoperative course uneventful for 5 days. Sixth day: severe spontaneous hæmorrhage from sinus; fever 103° with chill; leucocytes 34,600; blood culture negative. Seventh day: sinus ablated. Fourteenth day: fever 105.3°; blood culture negative: toxic nephritis; patient very ill: sinus bled at dressing; leucocytes 14,000. Twentieth day: somewhat improved; fever 102.8° with chill; blood picture the same; urine improved. Twenty-first day: internal jugular ligated. Twenty-eighth day: decidedly worse condition; failing fast; changed to a room with more sunlight. Twenty-ninth day: blood transfusion, citrate method, 500 cubic centimeters. Thirtieth day: improved. Thirty-fourth day: blood transfusion, 500 cubic centimeters. Thirty-seventh day: intravenous injection of 75 cubic centimeters of serum for foreign protein reaction. Fortieth day: injection of 75 cubic centimeters of serum. A decided change for the better, and gradual improvement took place. The radical cavity healed kindly. The patient is a nurse in training.

The severity of the patient's illness cannot adequately be described. In retrospect, it was necessary to operate on this patient in the manner followed in order to remove the disease. The spontaneous hæmorrhage from the sinus was unforeseen, although it was remarked at the time of the operation that something might be expected to happen to an uncovered sinus wall of such character, and the usual precautions in the postoperative dressings were carried out. The sloughing was very extensive and the bleeding difficult to control. It might be said that the vein should have been tied at the time the sinus was ablated; after the vein had been tied, however, there was little or no effect. On culture the blood and spinal fluid were repeatedly negative. Blood transfusion and forced diet were used as supportive measures. As the patient's general condition grew worse the leucocyte count decreased. The serum was given for the foreign protein reaction; the specificity of the infection was never determined. The nephritis cleared decidedly as the general condition improved. It is interesting to note that the pulse curve followed the temperature curve.

Case 5. (A113562.) C. E., a boy, age 12, was brought to the Clinic June 18, 1920, because of discharge from both ears. The onset of the trouble began 5 weeks before with pain in the right ear following a severe "cold." Paracentesis had been performed 2 days after the onset of pain with only partial relief. The left ear had ruptured spontaneously with complete relief from pain. One week and 2 weeks respectively after the onset, the boy had had chills and a rise in temperature. An abscess had developed in the right leg accompanied by chills and a temperature of 104°.

The patient was pale and presented septic facies. The canals of both ears contained a small amount of clear, odorless serum. The left ear seemed the more involved. The drums were somewhat reddened, but not bulging, and had small perforations in the posterior inferior quadrants with pulsating thin discharge. There was no drooping of the posterior superior canal wall on either side. Examination of the mastoids was negative but definite tenderness over the emissary vein was present on the left. An abscess on the ankle was draining. Examination of the fundi was negative. The temperature was 101°, and the pulse 118. The blood culture showed streptococcus hæmolyticus in 8 hours' time. The history of chills, the metastasis, the appearance of the patient, the clinical course, and the leucopænia suggested sinus involvement. A diagnosis was made of suppurative otitis media with mastoiditis, sinus phlebitis, and metastasis.

June 19, a complete mastoidectomy was performed on the left side and the sinus explored. The

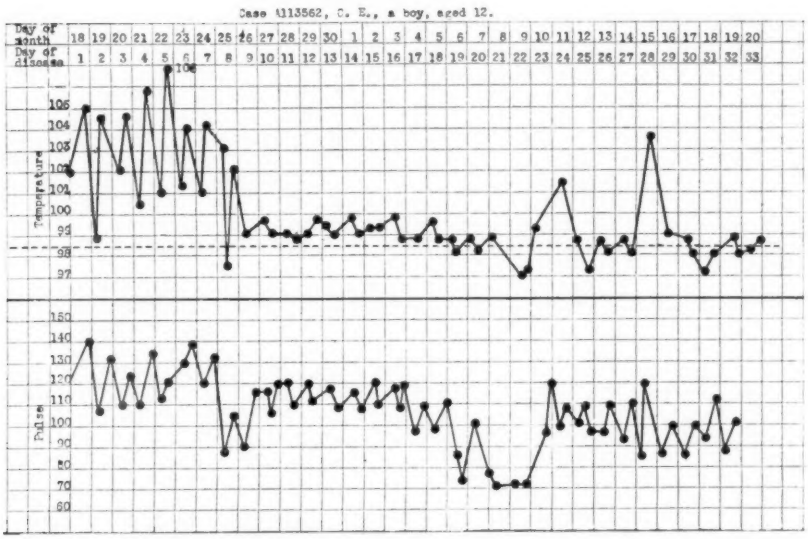

Fig. 5. Case 5. Postoperative course: Leucocytes 6,800. Bloodculture, virulent hæmolytic streptococcus in 12 hours. Definite general improvement for two days. Fourth day: slight swelling of discs; ankle cared for in orthopedic section. Fifth day: temperature rose to 106° following the dressing; patient chilly, restless at night; hæmoglobin 50 per cent. Sixth day: internal jugular vein ligated; blood transfusion; citrate method, Group 11, 500 cubic centimeters. Eighth day: much improved, blood culture negative. Ninth day: signs of pleural effusion, gradual improvement until the twenty-third day. Fever apparently due to food as a number of patients had the same reaction. Twentieth day: nothing to account for the fever. Thirty-third day: dismissed to out-patient service; has been seen at intervals since and is in excellent condition.

mastoid was of the hæmorrhagic type. The exposed sinus appeared normal and bled freely. Examination of the upper end for adhesions revealed a drop of pus coming from under the table. Exploration toward the torcular herophili brought to light definite phlebitis. The sinus was slit well back, allowed to bleed freely, and then packed. The patient was in good condition on leaving the operating room. The pathological process in the sinus was sufficient cause for the symptoms.

June 23, the jugular vein was ligated and sectioned at the level of the facial nerve; it was approached as in the ligation of thyroid vessels. The facial and lingual veins were tied off. The internal jugular was found to be thrombosed down to this region. Three hundred seventy-five cubic centimeters of blood was transfused without incident the same afternoon, the mother being the donor (Fig. 5).

It was necessary to choose the mastoid to be operated on. There was little difference in the appearance of the ears. The left was slightly more tender over the emissary vein and there were a few palpable glands in the left upper cervical region. The patient was so sick that the internist advised against operation, particularly in the presence of such virulent infection of the blood and the leucopænia. Operation was probably not necessary on the mastoid, except to check extension of the disease. The area of phlebitis was not in the mastoid itself, but posterior to it, and toward the torcular herophili. The ligation of the jugular vein and the transfusion had a beneficial effect, causing a definite change in the patient's general appearance. In this case also, the pulse curve follows the temperature curve.

The method of approach to the jugular vein in this case was not so satisfactory as that of incision along the anterior belly of the sternomastoid muscle.

Case 6. (A344815.) M. B., a girl, age 14, was examined in the Clinic, December 30, 1920. She complained chiefly of discharge from the right ear with slight swelling in the region of the mastoid; she had had chills and fever for 1 or 2 days. Twenty days before, she had had a very severe sore throat, and both ears had ached. Three days later both ears

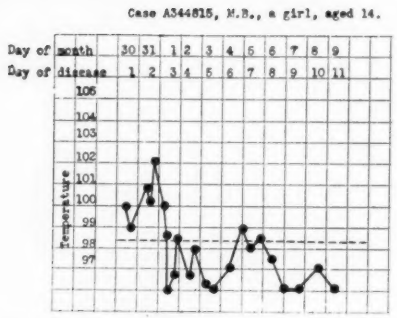

Fig. 6. Case 6. Postoperative course: Uneventful with the exception of choked discs on the twentieth day after operation. These gradually diminished. The patient was dismissed on the thirtieth day.

had begun to discharge and had continued for 2 days. About 10 days later, severe pain had occurred behind the right ear, followed by swelling, discharge, and increased temperature. The right side of the head was very tender to pressure and deafness was quite marked in the right ear.

Examination of the nasopharynx revealed a pad of adenoids; the right ear drum was red and bulging. The posterior superior canal wall drooped, but perforation and discharge were not visible. There was marked tenderness behind the auricle region of the tip. Hearing tests disclosed right combined deafness. A roentgenogram of the right mastoid showed some cloudiness. The patient had acute bronchitis; nevertheless, the acute condition of the mastoid made operation imperative. A diagnosis was made of suppurative otitis media with right subacute mastoiditis and sinus phlebitis.

December 31, a complete mastoidectomy was performed with exploration of the right sinus. The mastoid was quite unusual. On uncovering the cortex, it was found that mastoid cells had perforated over the posterior portion of the tip, the cells of which were extensively involved and the trabeculæ broken down. In the region of Trautmann's triangle, the probe dropped into a cavity which proved to be an exposed sinus. The antrum was contracted; the aditus was very small and situated well posteriorly. The sinus was exposed extensively toward the bulb and back over the knee until normal dura was revealed. After tamponing under the bone edges the sinus was incised and a definite mural thrombus encountered; this was sufficient to account for all the patient's symptoms. Bleeding was free from both ends. Paracentesis was performed. One pack was placed over the bulb, one over the knee end, and one in the mastoid cavity. A wick was placed in the ear (Fig. 6).

The vein might have been ligated at the time of the mastoid operation, but with the patient in fairly good general condition it was felt that the operation could be delayed to await developments. Although obliterating thrombus was not found, choked discs occurred.

Case 7. (A173075.) D. W., a boy, age 8, was brought to the Clinic January 11, 1921, because of discharge from the left ear, of 8 weeks' duration. Chills, fever of 104.5°, frontal headache, and dizziness had developed the day before. Only at the onset of the ear trouble had the mastoid been tender.

Examination revealed subacute otitis media on the left with sinus phlebitis so severe as to demand immediate surgical attention. The leucocyte count was 40,000. The patient was very restless and irrational with only periods of mental clarity. There was ptosis on the right, and discoloration of both lids. Extra-ocular movements were not involved. The mediums were clear. The fundi were negative. All positive findings had appeared in the last 12 hours.

January 31, complete left mastoidectomy was performed. On uncovering the mastoid the whole cortex was found to be bleeding. The mastoid was of the small-cell type; a large amount of pus welled up from below the knee of the sinus which lay well forward and had been exposed by the disease process. The zygomatic cells were filled everywhere with infected granulations. The distal and proximal ends of the sinus were packed off and the sinus was excised with free bleeding from both ends. Because of the findings it was thought that the perisinus abscess was the cause of the symptoms. It was considered necessary to await further developments before deciding whether or not a jugular ligation should be performed, as the infection might be direct into the bulb. The patient stood the operation well (Fig. 7).

Case 8. (A359149.) Mrs. D., age 41, was examined in the Clinic May 25, 1921. Her left ear had been painful and had discharged for 5 months; the swelling behind the ear had been variable; fever had persisted during the first 2 weeks. She had had constant pain on the left radiating over the occipital and parietal regions as far as the middle line. Spontaneous rupture had occurred the second day. Occasional tinnitus had been noted. The canal had been cleansed. Tenderness over the mastoid had developed 1 week later and remained. The patient's general health had remained good. There was a history of repeated attacks of tonsillitis.

Examination revealed profuse discharge from the left ear, and marked drooping of the wall of the superior canal. The canal refilled immediately after cleaning. There was no mastoid tenderness except over the emissary vein. The pus was too profuse to be accounted for on the basis of middle ear trouble alone. It was felt that the mastoid condition was surgical and that the lateral or sigmoid sinus was involved. A diagnosis was made of left mastoiditis, with perisinus abscess.

May 27, when the cortex was uncovered, many bleeding points appeared and when the outer table was removed a large quantity of pus welled up, pulsat-

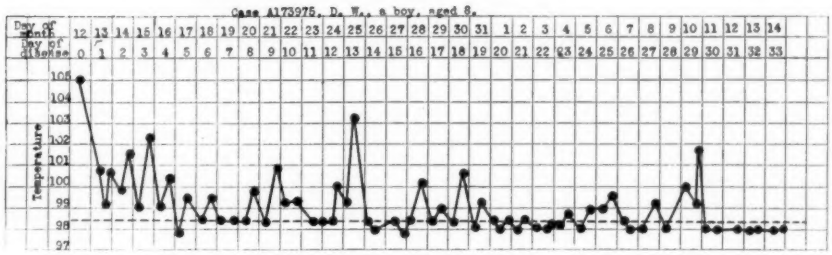

Fig. 7. Case 7. Postoperative course: Condition good after operation. Patient in Group III blood grouping. Ptosis of the right eyelid, but discoloration and œdema lessening. Fourth day: Wound clean; sinus bled on removal of middle pack; repacked with vaselined pack; lungs and heart in good condition. Ninth day: slight rise in temperature following removal of all packs. Temperature suddenly rose to 103.6°, painless otitis media, suppurative right side. Tenth day: temperature normal. Eleventh day: eye examination showed the veins of retinæ dilated, engorged, and tortuous; slight retinal œdema; discs not choked, only slightly swollen; leucocytes 15,000, not accounted for; slight rise in temperature; watched for signs of sinus involvement; pain in the right ear; membrane tympanum full, dull red, but no pain at examination; paracentesis. Sixteenth day: slight rise in temperature; no pulsation in sinus; wound in good condition; both ear canals filled with mucopus; the child had a slight rise in temperature intermittently for the remainder of his stay in the hospital; he gradually improved and was dismissed to out-patient service on the thirtieth day.

ing under pressure. Removal of the cortex revealed a very extensive cavity, extending over the temperosphenoidal lobe, the cerebellum, and the knee of the sinus, which were uncovered to a fairly healthy appearing dura. Pachymeningitis was definite. The sinus felt so cord-like that it was opened and an organized thrombosis not filling the lumen was found. Free bleeding occurred at both ends. One pack was placed over each end of the sinus and one in the mastoid cavity. Paracentesis was performed (Fig. 8).

SUMMARY OF CASES IN GROUP I

The jugular vein was not operated on primarily in any of the 8 cases in this group. In 3 (Cases 3, 4, and 5), subsequent ligation was necessary because of the patients' condition. The temperature charts of these patients demonstrate their extreme illness.

The leucocyte count was relatively high, except in Cases 2, 5, and 8, and in Cases 5 and 8 the condition was really leucopænia. One patient (Case 5) was extremely ill, and was found to have a very virulent infection of the blood stream due to hæmolytic streptococcus.

Blood cultures were positive in Cases 3, 5, 7, and 8, while in Case 4, in which the patient was most critically ill, cultures were repeatedly negative. No two patients were infected with the same organisms, and no regular interval elapsed before the blood culture became negative.

The temperature was fairly typical of sepsis, except in Cases 2, 6, and 8, in which it was almost afebrile.

Choked disc occurred in Cases 5, 6, and 7, probably the result of general toxæmia. Blood transfusion was used as a supportive measure in Cases 3, 4, and 5 with a rather striking result in Case 3. This patient was infected with streptococcus viridans and it is possible that the donor may have been immune to this bacterium. It was apparent that a bacterial shower occurred into the blood stream at the time of a postoperative dressing in Cases 1, 4, 5, and 7.

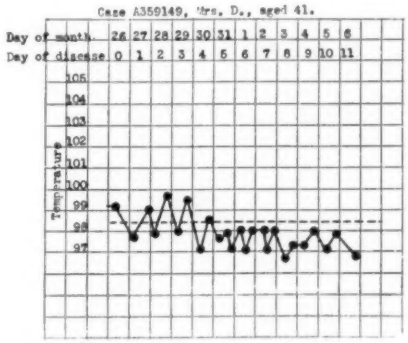

Fig. 8. Case 8. Postoperative course uneventful.

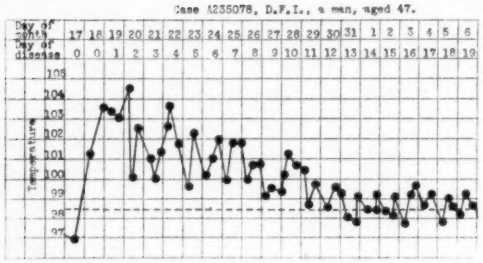

Fig. 9. Case 9. Postoperative course: First day: blood culture positive; long and short chain streptococcus; leucocytes 14,800; chest condition same; fluid not removed; respiration 60. Fourth day: blood culture negative; leucocytes 22,200; respiration gradually reduced and patient more comfortable. Gradual improvement continued until the twenty-second day; the respiration, pulse, and temperature ran a normal course for several days. The patient was dismissed on the twenty-fourth day following operation.

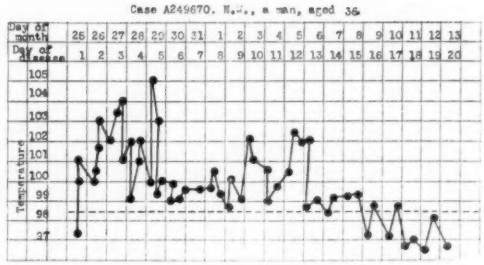

Fig. 10. Case 10. Postoperative course: immediate course stormy; high temperature, rapid pulse. Patient very restless and uncomfortable, difficult to manage. Resented examination and so forth. Blood culture negative 24 hours after operation. Fifth day: facial paralysis, which gradually disappeared. Sixth day: general improvement.

Blood serum immune to streptococcus hæmolyticus was injected intravenously on two occasions in Case 4. Blood culture in this case had been repeatedly negative. No systemic reaction occurred after the injection, but it is possible that there may have been a foreign protein reaction; at least the serum appeared to have a beneficial effect upon the clinical course.

In Cases 4 and 5 the pathological condition was phlebitis without evidence of thrombosis. It is interesting to note that these patients were the most critically ill. Pulmonary complication was present in Case 5, but the patient recovered.

GROUP 2

CASE 9. (A235078.) Mr. D. I., age 47, came to the Clinic June 13, 1918, because of discharge from both ears, appearing 2 weeks before. Paracentesis was performed without complete relief. The patient was kept under observation and the condition of the ear seemed to improve satisfactorily from day to day. After 2 weeks he became very ill with chills, pain in the chest, high fever, and severe prostration. He was sent to the hospital, and examination revealed pleurisy with effusion. The leucocyte count was high. A tenable diagnosis of sinus phlebitis was made.

July 19, under local anæsthesia, a complete right mastoidectomy was performed with ligation and resection of the jugular vein and ablation of the sinus. The knee of the sinus lay well forward, and in the region of the tip a pus pocket had uncovered the sinus wall. Further exploration revealed the sinus wall to be covered with plastic lymph and the sinus did not fill as usual; it was uncovered extensively and was incised without bleeding from the bulb end. After some difficulty because of its collapsed condition the vein was ligated below (Fig. 9). Chest complications contra-indicate any such operation under general anæsthesia; but it was believed that the patient's chances for recovery were poor without operation. Local anæsthesia was employed, therefore, with surprisingly little discomfort. The general care instituted was similar to that in cases of pneumonia.

CASE 10. (A249670.) Mr. N. W., age 36, came to the Clinic October 26, 1918, complaining of severe pain in the right ear, with chills and fever. The right ear had begun discharging pus several years before, following a "cold." Pain in the right ear and discharge had increased 10 days before. The patient could not rest at night; he had chills and rising temperature. He did not know how long he had been deaf in the left ear. He had been treated recently for typhoid.

The patient was so ill it was necessary for him to lie down during the examination. He held his head rigid and complained of any lateral motion of the head, but the neck was not stiff. The right tympanic membrane was present. A very small amount of discharge appeared to come from near the tube. The wall of the canal did not droop. The right mastoid region was extremely tender, especially over the emissary vein. The glands along the jugular vein were definitely palpable. The cochlea and labyrinth did not function. A diagnosis was made of chronic suppurative otitis media with mastoiditis, labyrinthitis, sinus thrombosis, and intracranial extension.

October 25, operation was performed. The mastoid cortex, thick and eburnated, bled everywhere. Rather dark pus oozed from above and around the knee of the sinus. The dura was covered with granulation. The sinus was uncovered extensively backward, and found to contain an obliterating thrombus. Bleeding occurred in the torcular end after removal of the thrombus. A large cholesteatoma filled the middle ear and eroded the pyramid so

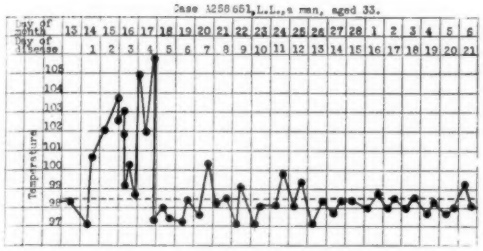

Fig. 11. Case 11. Postoperative course uneventful.

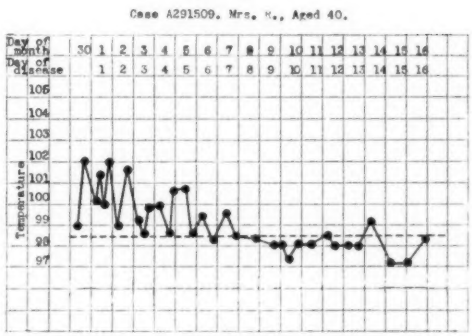

Fig. 12. Case 12. Postoperative course uneventful. The blood culture was negative on the fourth day.

that it was necessary to remove a large part of the petrous portion. Although the dura was exposed extensively, the adhesions were not incised. The facial nerve was found free in the cavity, uncovered by the extensive cholesteatoma. Jugular ligation, radical right mastoidectomy, resection of the petrous portion of the temporal bone, labyrinthectomy, sinus ablation, and extensive decompression were performed. A wick drain was left deep in the ear. Small packs were placed over the sinus and in the rest of the wound. Culture of the blood showed streptococci, pneumococci, and micrococcus catarrhalis (Fig. 10).

This patient had almost all possible complications, involvement being the most extensive in the series. The labyrinthectomy was performed after the method of Neuman and was easily accomplished because the cholesteatoma had destroyed the bone to such an extent that the facial nerve lay free in the cavity. Touching the nerve made the face twitch. Paralysis which developed on the fifth day began to improve after about 3 weeks. It is significant that this patient had been treated for typhoid fever before coming to the Clinic.

CASE 11. (A258651.) Mr. L. L., age 33, came to the Clinic January 31, 1919, because of chronic suppurative otitis media, with right mastoiditis. He complained of dull ache in the vertex of the head. He had had scarlet fever and measles in childhood. His right ear had begun to discharge 12 years before, following pain of a few days' duration. The ear had ruptured spontaneously and had discharged almost continuously until 1 year before, when the discharge had been scant. The patient had had tinnitus and had been dizzy at times but he had had no real attack of vertigo. The pain in the right mastoid region had been more severe when the discharge was scant.

Pus was noted in the middle meatus, especially on the left side of the nose. During examination of the right ear, a perforation in the region of the attic allowed the probe to pass into the attic, releasing a foul discharge. The cochlea and labyrinth did not function. Roentgenogram of the right mastoid region failed to give evidence of mastoid cells. Examination of the left ear showed a retracted drum. The teeth showed marked caries. A diagnosis was made of right chronic suppurative otitis media with chronic mastoiditis and latent labyrinthitis.

February 14, radical mastoidectomy and labyrinthectomy were performed. The mastoid antrum, the cortex of which was sclerotic, was filled with a cholesteatoma and granulations. The horizontal canal was largely destroyed and filled with granulations. The facial nerve, covered with granulations, was so superficial that manipulation repeatedly caused the face to twitch. During probing in the region of the tube in the hypotympanum, the jugular bulb may have been entered as considerable bleeding resulted, which was controlled with packs. The third day following operation the patient developed definite chills and fever. He was kept under observation, and after erysipelas or general conditions had been ruled out, it was deemed advisable to investigate the sinus.

February 17, a second operation was performed, consisting in jugular ligation and ablation of the sigmoid sinus. Incision caused bleeding from the lower end, but not from the upper. The sinus was slit widely and a large thrombus, 7.5 centimeters long, was removed; there was free bleeding posteriorly (Fig. 11).

There is nothing about the clinical course in this case that would not be considered typical and satisfactory. The thrombus was found in the lateral sinus and not in the bulb.

CASE 12. (A291509.) Mrs. A. W. R., age 40, came to the Clinic in an ambulance September 30, 1919, complaining of discharge from the left ear, pain at night, chills, and tenderness in the mastoid region. She had had trouble in the left ear intermittently for 4 years. The last attack began 10 days before following a "cold" in the head when the left

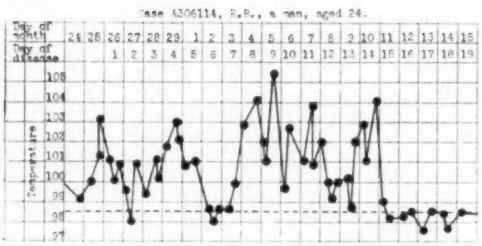

Fig. 13. Case 13. Postoperative course: For 7 days after ligation of jugular vein temperature curve indicated sepsis, but the patient felt much better. The blood culture became negative. There were no signs of meningitis except that the optic discs were blurred on the eleventh day. No explanation could be offered for the course, except that the blood infection was still present. Dismissed to out-patient service on the eleventh day following operation.

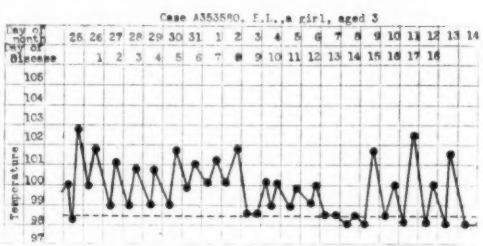

Fig. 14. Case 14. Postoperative course: No particular incident. Child sat up day following operation and played with toys. The temperature curve is best explained on the urine findings. The child was kept on alkalies. No signs or symptoms of illness at any time. As the condition of the urine cleared the temperature decreased.

ear had begun to discharge foul mucus. The region behind the left ear had become swollen almost immediately and chills had persisted for several days; the temperature had not been taken.

The canal wall of the left ear did not droop; there was a scanty discharge. The mastoid region was tender to touch at the tip, but not over the emissary vein; there was no swelling. The leucocytes numbered 7,900. Culture of the blood was positive for pneumococci.

October 19, operation was performed. The mastoid cells were filled with pus. The sinus was exposed by the disease process and the walls were eroded. An obliterating thrombus was removed and free bleeding from both ends resulted (Fig. 12).

The evidence on which the sinus involvement was diagnosed was the general appearance of the patient, the history of chills, and the positive blood culture. Recovery was unusually rapid.

CASE 13. (A306114.) Mr. R. B., age 24, came to the Clinic February 21, 1920, complaining of acute earache on the right side, of 10 hours' duration. Paracentesis gave complete relief.

The patient had severe follicular tonsillitis; there was considerable discharge from the right ear and some tenderness over the mastoid antrum. He was observed in the hospital for 5 days; the tonsils remained large. Roentgenograms did not show evidence of mastoid cells on the right. The leucocyte count was 11,000.

February 27, a complete right mastoidectomy was performed. A small contracted mastoid with sclerosis was revealed. The cells were small, some filled with infected granulations, and many with pus. The knee of the sinus lay well forward and the cells over the tip of the mastoid were fairly large. The sinus was purposely exposed over a large area. In the region of the middle ear the mastoid antrum was found to lie back, the aditus ad antrum was very small; these findings account for the condition. The patient was not subjectively improved after this operation (Fig. 13).

March 6, a second operation consisting of ablation of the sinus and ligation of the jugular vein was performed. The surgical diagnosis was perisinus abscess with sinus thrombosis. When the sinus in the old wound was uncovered, in the region of the bulb, a perisinus abscess was encountered containing about 1 dram of pus. After the sinus was uncovered toward the torcula and incised, an obliterating laminated thrombus was found. Free bleeding occurred from the torcular end, but not from the bulb. The vein was ligated, because it seemed to be collapsed above the region of the facial nerve. The patient was dismissed 1 month later, in excellent condition.

At the time of ligation, there was some question of the identity of the vein, but it seems perfectly evident that it must have been the jugular because there was no other vein near or in the carotid sheath.

CASE 14. (A353580.) E. L., a girl, age 3, was brought to the Clinic March 25, 1921, because of pain and swelling behind the right ear. After a severe "head cold" about 1 month before, pain had developed in the ear with spontaneous rupture within 3 days. Two weeks later the region behind the ear had become swollen.

The child did not look well. The canal of the right ear showed a thick purulent discharge and the superior wall drooped. A large red swelling fluctuated over the tip of the mastoid. The leucocytes numbered 20,000 and there were pus cells in the urine. The diagnosis was right mastoiditis with subperiosteal abscess.

March 26, operation was performed. A very large subperiosteal abscess and definite perisinus abscess were disclosed. The mastoid cells were broken down by the disease process, and the sinus was found to be obstructed by an organized thrombus. The bulb and torcular ends bled freely after the removal of the thrombus (Fig. 14).

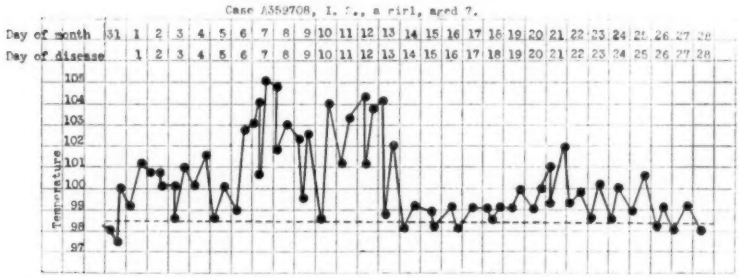

Fig. 15. Case 15. Postoperative course: First five days uneventful. Sixth day: temperature rose to 102.5°; blood culture, hæmolytic streptococcus; leucocyte count 5,200; spinal fluid, negative; patient appeared septic; no chills or sweating. Involvement of sinus suspected, although temperature remained high. Eighth day: transfusion; citrate method; 200 cubic centimeters. Ninth day: jugular ligation and ablation of the sinus; no bleeding from bulb end. Thirteenth day: symptoms have been fairly typical of sepsis; blood culture negative; leucocyte count 9,800; hæmoglobin 50 per cent; choked discs of both eyes with venous engorgement. From then on no particular incident. Patient dismissed to out-patient service on twenty-ninth day. The choked discs gradually cleared up during the convalescence.

This child was without history or signs of sepsis. Blood culture was not taken. There is little doubt but that this sinus condition would have spontaneously cleared up if the mastoid had been taken care of. The condition of the urine in such a case must be considered in searching for the cause for a rise in temperature.

CASE 15. (A359708.) I. S., a girl, age 7, was brought to the Clinic May 31, 1921, because of discharge from the right ear with swelling over the mastoid region, headaches, and fever. In the winter of 1920, 2 days after the onset of earache, she had had a right mastoid operation elsewhere, and completely recovered. In the winter of 1921, following a "head cold," the right ear had begun to ache, the drum membrane had opened, and the ear had started and continued to discharge pus. The swelling behind the ear had been becoming larger and more tender gradually. The child had been sick but did not have chills; her head had ached almost constantly.

Examination revealed frank mastoiditis on the right side. The leucocytes numbered 18,000, the hæmoglobin was 50 per cent. The urine contained pus cells. The child was sent to the hospital immediately.

June 1, operation was performed. The usual mastoid incision released several drams of fluid pus from a subperiosteal abscess. The outer cortex was necrotic and contained several fistulæ. A large cavity in the mastoid region was filled with pus and granulation. The wall of the sinus was exposed by the disease process, and was covered with granulation. The sinus was aspirated and found to be patent (Fig. 15).

Inasmuch as the postoperative course was without incident until the sixth day, it is probable that the thrombus formed after operation. Because the temperature was not entirely typical of sepsis there was some doubt as to the sinus involvement. Conditions in young children do not necessarily run a clinical course true to type. The positive blood culture confirmed the suspicion of sinus involvement. Choked disc appeared in both eyes, but examination of the spinal fluid was negative. The leucocyte count proved a fair index of this patient's condition; at the onset it was 18,000, but gradually decreased. The blood culture was negative seven days after the jugular operation.

SUMMARY OF CASES IN GROUP 2

In Cases 9 and 10 a primary operation was performed on the vein because bleeding did not occur from the bulb end of the sinus. In three cases (Cases 11, 13, and 15) the operation on the vein was performed secondarily, because symptoms and signs of sepsis came on during the postoperative course and at the second operation bleeding did not occur from the bulb end. In Case 13, the disturbance may have been present but not recognized at the time of the primary operation. In Cases 11 and 15, the condition may have resulted from injury to the sinus wall at the time of

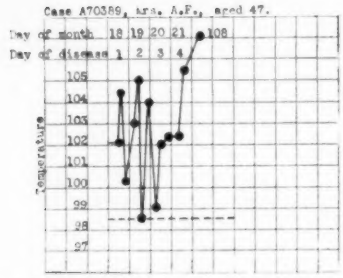

Fig. 16. Case 16. Temperature curve in a fulminating fatal case. No operation. Death on the fifth day.

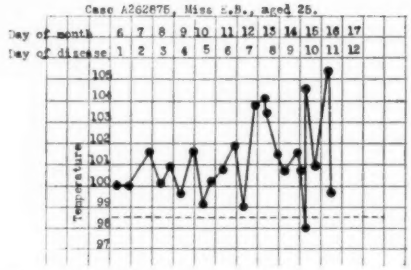

Fig. 17. Case 17. Postoperative course: First day: patient uncomfortable; indefinite chest findings only signs. Temperature curve not unusual. Fourth day: patient's skin discolored by touching. Patient delirious. Blood culture positive; short chain streptococcus. Patient failed fast. Sinus involvement indicated but operation seemed useless. Fulminating infection. Seventh day: definite chill; metastasis to joints. Twelfth day: gradually worse; death. Necropsy: Marked bilateral disseminated bronchopneumonia; fibrous adhesive perisalpingitis, and mural thrombus right lateral sinus.

primary operation; in Case 11, from injury of the bulb with a probe, and in Case 15, from injury by needle puncture to determine the patency of the sinus. In Cases 12 and 14, in which the vein was not disturbed, the patients had an uneventful convalescence. The leucocyte and differential blood counts were not particularly illuminating in any of the cases. The counts were not high, even in the presence of infection in the blood. The patient's general appearance seemed to be the best index of his condition.

In 6 cases the blood cultures were positive; in 1 case (Case 14) no culture was made. The patients were all infected with different organisms. The annoyance given the patient by daily blood counts and blood cultures is scarcely warranted in these cases. The temperature curve was quite characteristic in Cases 9, 10, 11, and 13, but in Case 15 it was definitely misleading. In Cases 12 and 14 the patients were nearly afebrile. Choking of the disc occurred in Case 15, and because of low hæmoglobin in this patient, blood transfusion was given as a supportive measure. The beneficial effect was immediate. Grouping before transfusing is imperative. In Case 9, operation was performed under local anæsthesia because of complication in the lungs. In general, it may be said that the patients in this group were not so extremely ill as those in Group 1. In no case was the vein resected. It is highly probable that the patient in Case 14 would have recovered even if the thrombus had not been disturbed.

It is significant that the patient in Case 11 had been treated elsewhere for typhoid in spite of disease in the ear and mastoid.

GROUP 3

CASE 16. (A70389.) Mrs. A. F., age 47, was examined March 18, 1919. She complained of sore throat of about 10 days' duration. Earache on the right had begun 6 days before with spontaneous discharge, chills and fever, and marked prostration.

Examination revealed the membranes of the throat to be full and red, the lips covered with sordes, the tongue dry and fissured, the soft palate and pharynx œdematous and dry, the right mastoid tender, the right ear discharging thin serum, the temperature 102.6°, the pulse 130, and the respiration 32. Signs of sepsis were definite. Blood culture showed streptococcus hæmolyticus. The leucocyte count was 20,800. Examination of the urine indicated toxic nephritis. A diagnosis was made of septic sore throat, and suppurative otitis media, with mastoiditis and sinus thrombosis (Fig. 16).

At first it was believed that the sepsis might be due to the condition of either the throat or ear, and it did not seem good judgment to operate. Death occurred on the fifth day.

Necropsy revealed (1) acute thrombo-ulcerative mitral and tricuspid endocarditis, (2) multiple metastatic arthritis, (3) thrombosis of the right lateral sinus, (4) left posterior ethmoid sinusitis, and (5) hæmolytic streptococci in the blood.

It is highly improbable that surgical interference would have terminated successfully.

CASE 17. (A262875.) Miss E. B., age 25, came to the Clinic March 6, 1919, with a discharging right ear. Following an acute "cold," she had had severe pain in the right ear, with spontaneous rupture in 24 hours. She had been unable to sleep because of pain. Profuse drainage had continued, and there

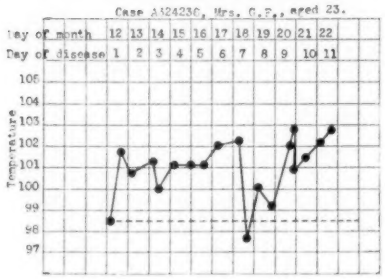

Fig. 18. Case 18. Temperature curve. Patient *in extremis* throughout. Late stage of the disease. No operation.

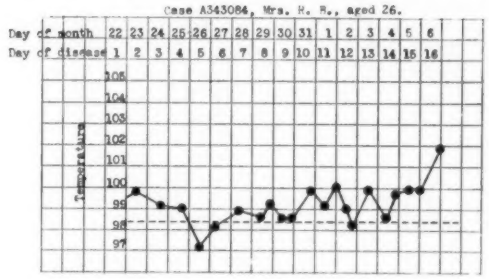

Fig. 19. Case 19. Nearly afrebile course of a fatal unrecognized case thought to be a temporosphenoidal abscess. Death occurred on the sixteenth day. Necropsy revealed thrombosis of the straight and lateral sinus.

was tenderness behind the ear. Paracentesis was performed without complete relief.

The patient appeared tired, pale, and sick. She was sent to the hospital. The mastoid was tender, the discharge from the ear copious. The leucocyte count was 14,200. Examination of the urine was negative.

March 10, a complete mastoidectomy was performed. The mastoid was the small-cell type, the mastoiditis hæmorrhagic. Cultures were made. The bone was not broken down. The sinus and dura were not uncovered. A gauze wick was left in the ear, and a vaselin pack in the mastoid (Fig. 17).

The patient's rapid failure was appalling. The influenza epidemic was at its height, and although the condition of the sinus was recognized, it was felt that further operation was not justified. However, if such a case were again encountered, it is probable that surgical interference would be instituted in order to make sure that everything possible had been done.

SUMMARY OF CASES IN GROUP 3

The 2 patients in this group were so extremely ill and the infection so overwhelming that operation was not attempted. The septic sore throat in Case 16 made it difficult to determine the true source of the sepsis, even in the presence of the suppuration of the ear. The patient in Case 17 did not do well from the beginning of treatment, and became mentally disturbed. Soft parts discolored if handled. The site of the needle puncture for the blood culture began to slough in 24 hours. It was believed, therefore, that surgical interference would be a useless and misdirected procedure.

GROUP 4

CASE 18. (A324236.) Mrs. G. F., age 23, was examined in the Clinic July 12, 1920, because of dyspnœa, discharge from the ears, delirium, and general bodily ache. She had had influenza 6 months before, from which she had not fully recovered. The present illness had begun about 6 weeks before, with measles or scarlet fever. After 10 days she had had a relapse with high fever and pain in both ears. The ears were opened, but she had since become progressively weaker and she had taken practically no food since the relapse.

General examination revealed evidence of pneumonia with effusion, strongly suggestive of tuberculosis. Both ears were suppurating. There was no mastoid tenderness or palpable cervical glands. Neurological examination was practically negative. Blood culture, July 14, showed pneumococci; July 19, culture was negative. The leucocyte count was 15,800; hæmoglobin 50 per cent. Examination of the urine was negative.

The patient was delirious and thoroughly septic throughout the course of the illness. She died after 11 days. At necropsy were found: (1) thrombosis of the right lateral sinus, (2) multiple abscesses of the lung, and (3) left empyema. Guinea pig inoculation revealed miliary tuberculosis of the liver, spleen, peritoneum, and pancreas (Fig. 18).

If a differential diagnosis had been made in this case operation would not have been warranted, because the patient was so extremely ill. In such a case it is possible for the end-stage to obscure the picture so greatly that thrombosis might be considered, but the management would not be greatly different. The ear was examined 2 days before death, when the patient was *in extremis*. No attempt was made to assign the cause of the trouble to an extension from the ear. If the patient had been seen 3 weeks earlier, the prognosis would have been better.

CASE 19. (A343084.) Mrs. B., age 26, came for examination December 7, 1920, because of severe headache and pain in the shoulder. She had had trouble with both ears since childhood. Four weeks before examination she had had a "head cold," followed by earache, more marked on the right. Discharge from the ears had afforded little, if any, relief from the headache. She had not been confined to bed. One day she had felt chilly. She had been markedly drowsy for several days, then improved for a few days.

The eye grounds were negative; the blood showed secondary anæmia; the leucocyte count was 7,800; the examination of the urine and roentgenograms of the chest were negative. The patient had many infected teeth. The canals of both ears were nearly occluded by fibromyxomatous polyps, which were partially removed to facilitate drainage. Tenderness was not demonstrated over the mastoid. The patient was advised to enter the hospital for observation, because of the possibility of intracranial extension, but she refused. Five days later, she felt worse and a physician was called to her boarding house. She was in a rather stuporous, apathetic state, and complaining of headache. She was taken to the hospital.

Examination of the spinal fluid was negative, the leucocytes numbered 9,800. The pulse was 60. Eye grounds showed slight haziness of the discs. The neurological examination suggested the possibility of abscess, but there were few positive signs.

Exploration was performed December 18, but abscess was not found. The evidence of pressure indicated encephalitis (Fig. 19).

The patient did not react well to the anæsthetic, continuing very drowsy and stuporous; her pulse was slow and full. The third day she was much clearer mentally, but her head ached severely, and her neck was rigid. Babinski's sign was positive; Kernig's was negative. The fifth day she was drowsy, but was aroused easily and appeared clear mentally. Her condition was not good. Little change had occurred on the seventh day. The tenth day, the culture of the spinal fluid, 32 cells, was positive; temperature and pulse rose slowly. The eleventh day, she suddenly became worse; tonic convulsion occurred, followed by difficult respiration, cyanosis, and death.

Necropsy revealed (1) organized thrombus of the right lateral and straight sinus, (2) hæmorrhage into the right temporosphenoidal lobe on the side explored, and (3) encephalitis.

The patient's home physician, after her death, told of having seen the patient early in the disease, at which time she had had definite chills and high fever. If this information had been available the involvement of the sinus would have been suspected. The patient had not been able to give her symptoms and her husband had appeared indifferent. The drowsiness, headache, and general malaise were probably owing to the intracranial circulatory changes resulting from the thrombosis of the straight sinus. This case and Case 18 illustrate the difficulty of recognizing a sinus involvement some weeks after the onset.

SUMMARY OF CASES IN GROUP 4

Case 18 represents a patient in the end stages, the result of septicopyæmia, when operation had been delayed too long. Her ear was examined 2 days before her death. The history was typical. It is interesting that the guinea pig into which the infection was injected died subsequently from miliary tuberculosis. The blood culture was positive for streptococcus hæmolyticus. Case 19 presented the most unusual clinical problem encountered. Thrombosis of the straight sinus probably accounted for the symptoms suggesting brain abscess. Death was due either to intracerebral hæmorrhage at the site of the exploration (but this may occur with any exploration and prove fatal), or to circulatory disturbance due to thrombosis. Headache, drowsiness, and mental apathy may be caused by circulatory changes secondary to thrombosis of the straight sinus. In the presence of such symptoms, brain abscess and thrombosis of the straight sinus must be considered in the differential diagnosis.

GENERAL CARE

In general, patients with involvement of the sigmoid sinus must have careful, cheerful nursing in well-lighted, well-ventilated rooms. In several instances remarkable improvement took place in patients who had been transferred from dull, cheerless surroundings to well-lighted, well-ventilated rooms. Such patients are immediately placed in the best possible quarters as a routine measure.

The nursing is an extremely important factor. It is customary to impress on the nurse that the recovery will depend largely on her efforts and hearty co-operation. Forced diet and large liquid intake should be encouraged as supportive measures even when the temperature is high. Unnecessary examinations, such as blood counts, blood cultures, and needless dressings, annoy the patient who

is using all available reserve to combat the infection. They may seriously handicap and prolong the convalescence and should be avoided.

CONCLUSIONS

1. Patients should be treated individually rather than by one routine surgical procedure.

2. Primary operation on the jugular vein is not definitely indicated unless bleeding does not occur from the lower end of the sinus.

3. The operation on the vein may be safely delayed, if both ends of the sinus bleed freely and the patient seems to be in fairly good condition. In none of the cases was the vein resected.

4. Too much dependence must not be placed on laboratory findings. The general appearance of the patient is a fairly reliable index of the condition.

5. Blood transfusion by the citrate method, care being taken properly to group the patient, is a valuable supportive measure.

6. Unnecessary handling and examination should not be done as it annoys the patients.

7. Forced feeding, quiet pleasant surroundings, and cheerful nursing are important factors.

8. Patients with lung complications may recover.

9. Thrombosis of the straight sinus may cause symptoms and signs of brain abscess.

10. The prognosis may be said to be fairly good if well-directed measures and timely surgical interference are employed.

RECURRENCES FOLLOWING OPERATIONS FOR INGUINAL HERNIA[1]

By WILLIAM HESSERT, M.D., F.A.C.S., Chicago

ALL surgeons admit a certain percentage of recurrences after operation for the cure of inguinal hernia, even when the wound has healed by primary intention. That infection is generally followed by a recurrence of the rupture requires no further comment, and it is not with this class of cases that the discussion which is to follow is concerned. This paper is confined to a study of the causes leading to recurrence in clean cases.

The average operator is prone to underrate the percentage of his recurrences. Patients with a recurrence are generally nursing a grievance and are not likely to return to the first operator. Only in clinics with enormous material can cases be followed up in sufficient number to supply data which will be of any value. In Bloodgood's opinion, statistics can be deemed absolutely reliable only when based on an actual re-examination of the patient by the original operator himself. It requires experience to detect an early recurrence, which might easily be passed unobserved by the general practitioner or by the patient himself. If the statistics of the various authors were compiled according to a definite standard, they would be of much more value than the divergent figures at present available.

Bloodgood, in 1919, studied the results of operation in Halsted's clinic in the early days when suppuration was frequent and found recurrences in 25 to 30 per cent of the cases. When the wound healed *per primam*, the recurrences were alleged to be 6 per cent. This estimate was probably much too low. Taking it all in all, most surgeons of modern times admit from 5 to 10 per cent recurrences, all cases considered.

Fantino's ratio in 4200 cases was 1.7 per cent. Twenty-seven of the 74 which recurred were direct herniæ. Downes records 10 per cent for direct herniæ. Coley's figures are low, probably because so many children are included in the series. They are 0.6 per cent for the Bassini, and 4 per cent for the Ferguson operation. Taylor's compilation of 816 cases of indirect hernia operated upon at Johns Hopkins Hospital represents what is probably a fair average, 5.6 per cent. Of Davis' collection of 1500 patients operated upon at the Massachusetts General Hospital, 15 per cent recurred. Judd, speaking of both

[1] Read before the Chicago Surgical Society, May, 1922. (For discussion see p. 527.)

varieties of hernia, states that 70 per cent of all recurrences come within the first 6 months, and 90 per cent within the first year. That a supposedly simple operation like a herniotomy, should, at the hands of the most expert technicians in the foremost hospitals, be followed by such a high rate of failure is significant. What is wrong? I should say that, fundamentally, it is the failure of the operator to individualize in each and every case. It is his failure, not through ignorance, but rather inattention, to observe carefully the structures laid bare in his dissection, to note the variations in the anatomical development, and to employ that plastic which is the proper one for the case at hand.

Moschcowitz tersely tabulated the causes of recurrence as follows, viz.:

1. Proper operation improperly done;
2. Improper operation properly done;
3. Improper operation improperly done.

The different factors, anatomical and technical, which are involved in a recurrence, can, for the purpose of study, be enumerated as follows:

1. The type of hernia—

Direct and indirect;

2. Variations in the normal anatomy of the inguinal region—

The conjoined tendon and aponeuroses;

3. The type of operation—

Involving mainly the question of transplantation of the cord and imbrication.

4. Sliding herniæ.

1. THE TYPE OF HERNIA

The ratio of direct to indirect herniæ is about 1 to 20. Recurrences in direct hernia are not only more frequent, but occur earlier than in the oblique. Coley states that 80 to 90 per cent of the recurrences in direct hernia occurred in the first year—the majority in the first 6 months. If a patient remains free from recurrence of direct hernia for the first 6 months, the probability is he will remain cured. In direct hernia, Coley had 15 per cent recurrence. Taylor reports 47 known results in direct hernia with 18 per cent failure.

Bloodgood, in 1918, wrote as follows about direct hernia: "There is, however, a small group of herniæ which can be easily recognized at the first examination, for which up to the present time (1918) operation failed to result in a cure in from 20 to 50 per cent of cases. I called attention to this small group of herniæ in 1899. Among 243 cases of inguinal hernia, this type occurred in eleven instances, about 4.5 per cent. Among these 11 cases there were 6 recurrences in from 6 weeks to 6 months after operation. In the larger group there were 1 per cent recurrences."

What is there about a direct hernia that makes it more difficult to cure than the indirect?

In the first place, the anatomical defects in the shape of deficient conjoined tendon are not considered by the operator in choosing the proper operation. Again, the sac did not receive proper care as to removal or inversion. A Bassini or Ferguson, without transplantation of the cord, would surely result in failure. Transplantation of the cord, according to Halsted, with an Andrews imbrication, is the best technique for these cases. If additional firmness is desired, a flap of fascia from the rectus sheath will answer the purpose better than to transplant the rectus muscle.

2. VARIATIONS IN THE NORMAL ANATOMY OF THE INGUINAL REGION

The conjoined tendon. In a paper which I read before this Society in January, 1913, entitled "Some Observations on the Anatomy of the Inguinal Region, with Special Reference to Absence of the Conjoined Tendon," I described my clinical findings. I called attention to the frequency with which the conjoined tendon was found attenuated or entirely absent, and described the condition fully. It was my opinion then, as it is now, that this anatomical defect had much to do with the original development of direct hernia, as well as with recurrence, especially if the improper operation had been performed. Prior to my publication, Bloodgood had been the only one to pay any particular attention to the conjoined tendon. I was at that time ignorant of his work and my observations had been made independently. My paper passed quite unnoticed, but it will appear evident from quotations from Bloodgood

which will follow presently, that he appreciates more than ever the importance of this matter. The profession, as a whole, judging by the literature, is still indifferent.

In my paper I asserted that the deficiency of the conjoined tendon could be detected clinically by the examining finger before operation, and since that time I have repeatedly demonstrated at operation that the palpating finger is correct in diagnosing absence of the conjoined tendon.

Associated with absence of the conjoined tendon it has been my experience to find developmental defects of the external oblique fascia. This fascia over the inguinal canal will be found to be thin and atrophic, with its fibers separated and even displaying the muscle underneath. In these cases the external ring is abnormally large, admitting the tips of one or two fingers easily. This condition of atrophic fascia and large external ring is not the result of a hernial protrusion, for it is demonstrable in cases where no hernia exists. Such a condition can be called a "predisposition," and when it accompanies a real hernia on the other side, it should be operated upon.

Bloodgood says: "In these cases in which this examination detects the complete absence of the conjoined tendon, the ordinary operation for inguinal hernia, according to my investigations up to 1899 failed to cure in about 50 per cent of the cases. The majority of operators today admit about 5 per cent recurrences in all cases of hernia. I am of the opinion that the majority of these recurrences are not due so much to the fault of the ordinary operation, as to the type of hernia and the absence of the conjoined tendon." Bloodgood has read most of the contributions of the surgeons who operated in our various training camps during the war and has failed to find a single mention of the conjoined tendon.

Bloodgood employs the term "obliteration" in discussing the various degrees of maldevelopment of the tendon. This term would imply the previous existence of the structure, and that it had been caused to shrink or disappear entirely by some outside agency, like the pressure of a hernial sac.

That Bloodgood himself felt some uncertainty regarding this term is shown by what he wrote in 1898: "The term 'obliterated' is used because the extreme condition is more likely to be an acquired one rather than congenital." I believe in the congenital theory because the extreme condition or complete absence of the tendon is often found where there is no hernia present at all, and even if a hernia is present, it is not the cause of the atrophic condition of the tendon, but a result of the same.

However, the important point to be recognized at the operation is that the conjoined tendon is either absent, very narrow, or very attenuated, and that the lower angle of the inguinal canal (Hesselbach's triangle) has lost its strongest support and that something must be substituted for this defect at the operation for hernia. Bloodgood recommended transplanting the rectus muscle down to Poupart's ligament, but Halsted never advocated the employment of this feature, maintaining that the rectus muscle in functioning would tend to draw back into its natural position. This was borne out by the experience at Johns Hopkins, for in 34 cases in which it was tried there were 35.3 per cent recurrences.

Taylor found that among his cases where the conjoined tendon was absent recurrences took place in 37.5 per cent.

I want to emphasize that in cases where the conjoined tendon is absent, a Bassini operation cannot be performed, for it is physically impossible to bring the innermost fibers of the internal oblique and transversalis muscles down to the spine of the pubes. I believe it is owing to the persistence of operators in employing the Bassini method in direct or indirect herniæ with absent conjoined tendon, that many recurrences are traceable. The technique which fulfills the indications is the imbrication method, after Andrews for the oblique variety, and with the Halsted cord transplantation for the direct hernia.

3. THE TYPE OF OPERATION

In the various operations in which the cord is not transplanted, whether the aponeurosis is overlapped or not, the possibility of a

recurrence always exists at the point of emergence of the cord at the median angle of the plastic. It is self-evident that any operation in which the cord is not transplanted, as in the Ferguson, is bad in direct hernia with absence of the conjoined tendon. In this connection Coley's statistics are suggestive, for, while he had 0.6 per cent recurrence following the Bassini method, there were 4 per cent following the Ferguson, in which the cord is not transplanted.

Coley believes that it is a great disadvantage to bring the cord out superficial to the aponeurosis and covered only by skin. The disadvantages of the Halsted operation have been the recurrences at the site where the cord came through the aponeurosis. Coley believes that the cord should be covered by fascia as in the Andrews' method. It is true that in indirect herniæ the Halsted operation is not the best choice, for it leaves a weakness in the aponeurosis at the internal ring, which is just the point where this hernia is most likely to recur. In direct herniæ, however, the Halsted operation with imbrication is best, for the cord is kept away from the point of greatest weakness, the inner angle.

4. SLIDING HERNIA

Judd had 14 cases of sliding hernia with 3 recurrences. I believe that, were the facts known, it would be found that most sliding herniæ recur. This is to be expected when you consider what a sliding hernia is, and that at operation one of the fundamental conditions for cure cannot be complied with, namely, excision of the sac. With this handicap, these cases present a difficult problem indeed. Various plastics on the bowel have been devised to do away with the sac, but without much ultimate success. These patients are usually fat, with atrophic muscles and friable tissues, making any kind of repair difficult. If the cord could be eliminated, it would add greatly to the stability of the repair. Castration is justifiable, the patient consenting. If one is accustomed to operate under local anæsthesia, that question can be settled on the spot. The cord removed, it is then a matter of layer sutures, taking care that no weak areas are left.

Recurrences have their beginning as a general rule at two points: (1) at the internal ring, and (2) at the external ring.

1. AT THE INTERNAL RING

Among the causes for recurrence at the internal ring are (a) faulty ligation of sac, (b) faulty suturing about the internal ring, (c) Halsted transplantation of the cord, without excision of varicose veins or lipomata.

a. Faulty ligation of sac. The most essential feature of every hernia operation is the high ligation of the sac. This has been well brought out by the fairly good results obtained by the simple operation of Kocher. One of the points emphasized by Halsted in his early work was the high ligation of the sac. There seems to remain little of the original operation of Halsted and Bassini that is really essential, except the clear and free exposure of the entire inguinal canal, which makes possible the high ligation of the sac. In children, high ligation alone will cure the rupture irrespective of the plastic. While no one will gainsay that recurrence is invited by a low ligation, which leaves behind it a funnel of peritoneum, yet many operators are at times careless in this matter. A preformed sac, even though it be small, will be the starting of a hernia. To eliminate any possibility of dimpling at the point of ligation, some operators draw the stump away from the internal ring and anchor it to the muscles.

How important a preformed sac is in the production of indirect hernia was first brought out in a paper which I read before this society in 1910 on "The Frequency of Congenital Sacs in Oblique Inguinal Hernia." I expressed the opinion at that time that most indirect hernial sacs had their beginning in a patent tunica vaginalis. That this opinion on the etiology of indirect inguinal herniæ is being shared by others, is shown in an article by Masson, in the *Collected Papers of the Mayo Clinic* for 1918. Masson states: Probably 75 per cent of all indirect herniæ are the result of a persistent congenital sac."

What disposition should be made of the sac in direct herniæ? We all agree with Bloodgood that in small direct herniæ not much is gained by opening the sac, and that when

one pulls it out for high ligation there is some risk of injury to the bladder. There is no evidence that failure to open, partially excise, and close a sac of this kind has anything to do with recurrence. A simple way to dispose of a small unopened sac is to insert a circular purse-string suture and invert.

When the sac is of larger size, it had best be opened and excised, keeping in mind always the bladder, which may be on the inner side of the sac. In the case of a double or pantaloon sac, it has been suggested that one pull the direct sac to the outer side of the deep epigastric vessels and tie off the two sacs as one. While this maneuver has no advantage over separate ligation, it may be followed by injury to the vessels and troublesome bleeding.

b. Faulty suturing about the internal ring. The so-called internal ring is not so much a ring anatomically as it is a weak spot. The cause of the weakness is the migration of the testis. In all hernia operations this region should receive especial care in suturing. I believe Coley was the first to advise one or two sutures of the tissues above the cord. Thus, in the Andrews imbrication, the structures are sutured from the spine of the pubes to the internal ring. Thereupon a suture is placed above the cord leaving an opening just large enough to avoid constriction. This suture includes the edge of the external oblique fascia and internal oblique muscle, which are sutured to Poupart's ligament. I consider this suture second in importance only to the one at the pubic spine.

c. Halsted transplantation of the cord, without excision of varicose veins or lipomata. The view is held by many that the straight course of egress of the cord at the internal ring creates a weak point. This is true to a certain extent, especially if the sac has been tied too low and no reinforcing suture has been put above the cord. For this reason this plan of disposing of the cord is advisable in direct herniæ only. In the indirect herniæ, the Andrews imbrication is much to be preferred.

Now as to the veins. If the veins could be excised in every case of inguinal hernia and the remainder of the cord transplanted without any danger of orchitis and atrophy of the testicle, a perfect result would probably be accomplished in every case. In case the veins are at all in excess of the normal, they should be excised. Due caution and proper judgment should be exercised lest too many vessels are removed and atrophy of the testicle result.

The fatty tissue which accompanies the cord and is often excessive in amount should always be dissected out and removed, that the size of the cord may be lessened. Failure to observe this simple measure may cause trouble.

2. AT THE EXTERNAL RING

Recurrences may point at the external ring and for reasons as follows:

a. Direct hernia in which the wrong operation was done, such as a Bassini or Ferguson in case of absence of the conjoined tendon. After any operation in which the cord is not transplanted, recurrences may take place at the inner angle.

b. Indirect herniæ during the process of recurrence may traverse the inguinal canal and appear at the external ring. This would apply to the Bassini or Andrews rather than to the Halsted operation.

TECHNIQUE

The various operations for inguinal hernia as they are being performed today are all more or less based upon the primary Bassini or Halsted technique. In this country the MacEwan and Kocher operations are no longer in vogue.

Whether the cord is transplanted, as in the original Bassini, original Halsted, posterior Andrews, Torek, Hackenbruch, or Fournel operations, or whether the cord is left in place without overlapping of the external oblique fascia as in the Bull-Coley, Ferguson, or Woelffler, or with imbrication of the aponeurosis as in the anterior Andrews, Girard, or improved Halsted (the so-called Hopkins operation), the essential underlying principle is the removal of the sac and the closure of the hernial opening by suturing the internal oblique muscle and conjoined tendon to Poupart's ligament.

No one operation will fit all cases, but by observing the general fundamental principles, it will be found that the technique need not vary greatly to be generally useful. I have found the Andrews imbrication operation to be the one which best fulfils all possible indications. The only variation in the technique relates to the disposition of the cord. I never leave the cord in its original bed to emerge at the inner angle. The cord should always be transplanted. In direct herniæ the cord is allowed to emerge directly through the aponeurosis as in the Halsted operation. In indirect herniæ the cord lies between the two layers of imbricated external oblique fascia.

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ACUTE INTESTINAL OBSTRUCTION IN INFANCY AND CHILDHOOD

A Brief Review of 55 Cases

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ACUTE intestinal obstruction is fraught with such real danger to the patient and attended with such grave responsibility to the physician, as to make it the most serious surgical affection of the abdomen, in early life. In pediatric practice, other surgical diseases, for the most part, tend toward spontaneous recovery if proper palliative measures are instituted. Conservatism does not carry with it the same risk, and delay is not so apt to spell disaster.

During the last decade experimental research has thrown much light on the physiological, chemical, and pathological problems of acute intestinal obstruction. Leaving out of consideration any purely theoretical or conflicting views, Stone[2] sets forth the following points as being generally accepted:

1. There is found in the lumen of obstructed bowel a toxin which, when injected intravenously into normal animals, causes the symptoms of intestinal obstruction.

2. Certain chemicals are developed, as the result of protein disintegration, and cause the symptoms present in acute intestinal obstruction, viz., fall in blood pressure, temperature disturbances, vomiting, diarrhœa, derangement of kidney function, high non-protein blood nitrogen, delay in coagulation time of blood, profound congestion of duodenal and jejunal mucosa, collapse and death. Death is due to a form of chemical intoxication.

This paper is based on a study of 55 cases of intestinal obstruction occurring in 53 young subjects. One infant, in a period of 4 months was operated upon twice for acute intussusception and once for postoperative adhesion obstruction. Cases of imperforate anus, congenital intestinal atresia or stenosis, and strangulated external hernia have not been included in this series. A few general facts will be noted: The obstruction developed in infants in 43 instances (78 per cent) and in children (ranging in age from 20 months to 11 years) 12 times. Males were affected twice as often as females, there being 36 of the former and 19 of the latter. With regard to the cause of the obstruction, the cases may be divided into the following groups:

1. Early postoperative band or adhesion obstruction (within 3 weeks of operation), 2 cases. Both cases developed in children shortly after operations for appendicitis.

2. Late postoperative band or adhesion obstruction (developing after 4 weeks), one

[2] Stone, Harvey B. The toxic agents developed in the course of acute intestinal obstruction, and their action. Surg. Gynec. & Obst., 1921, xxxii, 415.

[1] Read before the Surgical Section of the New York Academy of Medicine, March 3, 1922.

case occurring in an infant, who had recovered from an operation for double intussusception 5 weeks before.

3. Band or adhesion obstruction (without previous operation), 2 cases. The first case was in an infant and the obstruction was caused by a congenital band, from the cæcum to the jejunum, producing angulation and acute obstruction. The second case was in a girl, 8 years old, with appendicitis as the cause of the obstruction.

4. Tumor obstruction, one case, in a 5 weeks old female infant, with a benign tumor (probably an adenocystoma) at the ileocæcal valve.

5. Mesenteric thrombosis, one case, in an infant, with eighteen inches of gangrenous obstructed jejunum.

6. Pressure obstruction, one case, in a child with an intra-abdominal abscess, left side.

7. Foreign body obturation obstruction, one case, in a girl of 11 years who had eaten heartily of plums and had swallowed the stones.

8. Intussusception, 46 cases.

It will be seen that, aside from intussusception, acquired types of intestinal obstruction are relatively rare. In this series intussusception was the variety of obstruction encountered in 83.63+ per cent of our cases. While it may occur at any age, it is essentially and pre-eminently an affection of infancy and early life. A detailed description of the disease will not be given as this has been done in previous papers on the subject. Certain previously uttered statements will be repeated here, in order to emphasize the following points:

1. The cardinal symptoms—pain, shock, vomiting, mucohæmorrhagic stools and the presence of an abdominal tumor—occur so regularly and in such a clear cut and characteristic way as to make intussusception the easiest of abdominal diseases to diagnosticate. It is evident that the rapidity and severity of these symptoms and the course of the disease are in definite relationship to the degree of circulatory obstruction and to the poisoning which results therefrom. The morbid anatomical sequence in the acute variety is as follows: invagination, circulatory stasis with exudation and œdema, infection, inflammation and gangrene of the intussusceptum (Senn).

2. Differential diagnosis seldom presents any difficulties. Ileocolitis (acute dysentery), uncomplicated abdominal purpura, and spastic colitis are diseases which must be borne in mind and ruled out. If there is any doubt in a given case it can, as a rule, be settled by a fluoroscopic or X-ray examination.

3. Experience has shown that 10 per cent is a liberal estimate to be placed on the cases that can be disinvaginated by gas insufflation or hydrostatic pressure. The uncertainty, the danger, and the relative futility of aero-hydrostatic measures are not sufficiently understood or appreciated. Early operation is the safest, the simplest, and the only certain plan of treatment, and gives almost uniformly good results in all types of cases, regardless of the age of the patient.

Of the 46 cases of intussusception here considered, 39 were under my care and 7 were under the care of my associate, Dr. W. M. Silleck.

Age. Thirty-nine cases were in infants ranging in age from 6 days to 13 months, and the 7 older patients were from 20 months to 8 years of age.

Sex. There were 31 males and 14 females.

Clinical picture. The physical condition of 36 of the infants was exceptionally good; 2 were in but fair shape; and only 1 of the series was decidedly subnormal. The majority were breast-fed, well nourished, and previously healthy babies. Only 2 of the infants were on artificial feedings exclusively. The condition of the 7 older patients was fully up to the average.

The onset of the attack was more or less typical in all of the cases. Pain was uniformly present. Some degree of shock was noted in most instances. A few cases showed actual collapse during the initial seizure of pain, but there was always more or less reaction later. Vomiting or regurgitation of stomach contents occurred in every case. Vomiting is rarely a prominent symptom until late in the disease. When it appears early and is persistent we have come to look upon it as highly

significant of circulatory strangulation, with the prospect of a rapidly developing gangrene of the intussusceptum. Mucohæmorrhagic stools were present in 44 cases (about 95 per cent), absent in but two. A distinct tumor or tumefaction was felt in every case, with but two exceptions.

Varieties. Following the simple classification, suggested by Clubbe, our cases can be divided into the following groups: enteric, 3 cases; ileocæcal, 31 cases; enterocolic or double intussusception (entero-ileocæcal and ileocolic-colic), 8 cases; colic, 2 cases. In two instances where no operation was performed the type of invagination was not determined.

Etiology. In two cases, in boys aged 4½ and 7 years, respectively, a Meckel's diverticulum was the causative factor in the production of the intussusception. In another case, in a 6½ months old male infant, a congenital tumor of the cæcum (cystadenoma) was the cause. In another infant, the last 2 inches of ileum, *not involved in an ileocæcal intussusception*, appeared macroscopically to be the seat of a papillary angiomatous growth. The pathologist, however, pronounced the growth to be merely inflammatory. Appendicitis is believed to have been the causative factor in several instances. It has always been our rule to make the removal of the appendix a step of the operation, believing that occasionally appendicular irritation induced the spasm and brought about the invagination. Since the histological study of these appendices has been taken up as a routine measure, it has been found that a certain number of them show definite, acute inflammation, even where no trauma to this organ was present. It is hoped that others will make investigations along this line, for we are convinced that appendicitis is one of the causes of intussusception. Enlarged mesenteric glands were found in a considerable proportion of our cases, but were thought to be the result rather than the cause of the trouble. In the majority of our cases we were unable to find an unmistakable causative factor to account for the intussusceptions.

Recurrence. There were but two cases in our series in which recurrence took place. In the first case, there was a return of symptoms in an infant, upon whom Dr. Silleck had operated 2 days before for ileocæcal intussusception, and, on reopening the abdomen, he reports the finding of a recurrence at the same site, with gangrene of the neck of the intussusceptum, necessitating a resection. The second case was operated on by me for an entero-ileocæcal intussusception. Reduction was difficult and convalescence stormy. Five weeks later I operated a second time for acute obstruction of the lower ileum caused by adhesions. Two months later symptoms of intussusception developed, and, at the operation, performed this time by Dr. Silleck, an ileocæcal invagination was successfully reduced.

Results. One infant who had been ill for 7 days with intussusception was moribund when brought to the hospital and died within an hour of admission. Another late case, ill for 3 days, died on the operating table just as the operation was started. A gangrenous, irreducible, double intussusception was removed postmortem. There was but one successful reduction, without resort to laparotomy. The patient, a girl of 5 years of age, was seen in consultation with Dr. A. H. Cilley and presented the usual history and symptoms of intussusception. Following hydrostatic pressure and postural treatment, relief was obtained. Of the remaining 43 cases, 28 were reducible and 15 were either gangrenous or irreducible or both. In the first group there were 3 deaths, due to an overwhelming toxæmia, 9 hours, 7 hours, and 5 hours after reduction, in infants who had been ill 4 days, 3 days, and 3 days, respectively. Another fatality occurred in a boy who developed a colic intussusception while ill with influenza, during the 1918 epidemic. Reduction was accomplished with ease, about 6 hours after the onset, but death followed 4 days later, and was due to a double influenza pneumonia. Another case developed pneumonia after leaving the hospital and died of this disease on the fourteenth day following operation. Another late death occurred in a 4 months old infant, 21 days following operation, after dismissal from the hospital. In this instance the cause of death was not determined. To sum up the

results in the reduction cases: There were 22 cures and 6 deaths, mortality 21.42+ per cent. If allowed to exclude the deaths not directly due to the intestinal obstruction or to the surgical treatment thereof, the mortality would drop to 10.71+ per cent. There were several recoveries in late and profoundly toxic cases. The longest interval between the onset of the disease and a successful reduction was 4 days; the shortest was 5 hours. Every case in this group seen within 48 hours of the onset recovered, with the single exception of the boy who died of influenza pneumonia.

In the second group of 15 cases requiring resection there were 4 recoveries and 11 deaths; mortality 72.4 per cent. Of the thousands of cases of intussusception which have been reported throughout the world, there are on record less than a score of successful resections in infants. In older children the statistics are not quite so appalling. I had the honor, in 1905, of presenting before the Surgical Section of the Academy of Medicine the first successful resection of a gangrenous intussusception in an infant on record. Since that time I have had two other successful resections, one in an infant 8 months old and the third in a boy 4½ years old. The fourth successful operation in this series was performed by Dr. Silleck.[1] Of the 11 fatal cases, 9 were in infants.

When this series of intussusception cases is studied as a whole one is impressed with the large proportion of late cases. More than two-thirds were received into the hospital after the first 24 hours, and about one-third of the total number required resection. In spite of the fact that diagnosis is easy, no class of cases is more often unrecognized and mismanaged.

There were 22 deaths in this series of 55 cases of acute intestinal obstruction in children, giving a mortality of 40 per cent. This includes the fatalities from all causes, early and late, regardless of whether the patient received treatment or not. The most important factor in this intestinal obstruction problem is to operate early, before involved tissues have undergone serious damage, and before toxæmia has become pronounced. It is the only way to lessen the great morbidity and to reduce the high mortality, which inevitably accompany delay. Finney says it is better to have the operation done early than well. Better a poor operation on a patient in good condition than a good operation on a patient in poor condition. Van Beuren makes the axiomatic statement that the longer a patient lives with acute intestinal obstruction before operation, the sooner will he die after operation. So much for this phase of the question! Experience has taught us that occasionally an apparently hopeless risk can be converted into a fair sort of a gamble by treatment which combats shock, tissue desiccation, and toxæmia. External heat, appropriate stimulation, stomach lavage, the introduction of fluids into the system by infusion or hypodermoclysis or proctocylsis, are just as much indicated, in selected instances, before operation as after. Following the operative relief of the obstruction, in addition to the measures just mentioned, morphine, atropin and pituitrin, if used judiciously, are agents of proven worth. If threatened gangrene or perforation of the bowel does not force the operator to take radical steps—then a two-stage operation will often prove successful where a single procedure might have resulted in failure. The importance of emptying the loaded segment of bowel above the obstruction is obvious. Cæcostomy in acute obstruction of the large intestine, and enterostomy (particularly jejunostomy) in obstruction of the small bowel—to precede or to accompany the operation for the relief of the obstruction—are often life-saving measures. A local anæsthetic should be the anæsthetic of choice, in many of these operations.

[1] Silleck, Walter M. Med. Rec., 1921, May 21.

PERIOSTEAL SARCOMA IN ASSOCIATION WITH OSTEOMYELITIS

Report of Three Cases[1]

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WHEN, after receipt and study of material from the first case of periosteal sarcoma associated with osteomyelitis, Dr. Bloodgood wrote that he had "never observed sarcoma in osteomyelitis" it occurred to me that it would be of sufficient interest to report. A second case a few months later emphasized this, and finally a third case since the title of the paper was sent to our secretary. I wish simply to record the clinical observation of the cases.

Case 1. University Hospital No. 19647, admitted July 21, 1920. Miss C., age 14, white, suffered with periosteal, large round-cell, alveolar sarcoma of the left tibia with osteomyelitis. The onset was six weeks before admission, with pain in the left knee and leg. Swelling developed just below the knee in a few days, and was lanced but nothing was obtained although the X-ray had shown an osteomyelitis of the upper end of the tibia. Examination on admission to the hospital showed a slight swelling about the knee and the leg a trifle warmer than the right. There was a wound, covered by a dry scab 1 centimeter long on the anterior surface just below the knee. The surrounding skin was red for about 1 centimeter, and the region sensitive upon pressure, lessening as one went farther away, but extending up to the head of the tibia and down about midway the leg. No fluid was found in the knee. Motions of the leg were a little painful. There was no history of trauma, of typhoid fever or any other serious illness. Her temperature did not exceed 99.3°, pulse rate 125 to 150. The urine showed albumin, a few waxy and hyaline casts, and a few red blood cells. Leucocyte count, 16,500. Wassermann negative. X-ray report July 25, 1920: Upper end of left tibia shows osteomyelitis with destruction of cortex of bone anteriorly.

Operation, July 29, 1920, Dr. J. H. Kite, resident surgeon. Removal of entire anterior half of the tibia from just below the upper epiphysis down to midway the leg. Pathological report of material removed was osteomyelitis with staphylococcus aureus in pure culture. Operation was followed by Carrel-Dakin treatment. Progress was apparently uneventful except the pulse rate remained high and granulation tissue grew very fast such that wound was frequently cauterized with silver nitrate. After 6 weeks (September 11, 1920) the granulation tissue was so abundant that it was removed with a curette down to the bone, the upper end of which was also curetted. Following this the temperature rose to 102° daily and the pulse was still rapid. She began to grow weaker, anæmic, and coagulation time increased to 10 minutes, tested because the dressings were associated with rather free bleeding. Two weeks later the granulation tissue was again overabundant and I was asked by the resident to see her. X-ray showed a large amount of bony production invading the soft tissues around the upper end of the tibia and seemed to be out of proportion to the amount of callus that would be expected. Sarcoma was strongly suggested. X-ray of the lungs was negative. A section was taken from the depth of the wound but showed only infected granulation tissue. This was repeated with the same findings. The general condition of the patient was poor, she was anæmic and weak, leucocyte count, 3,200, red blood cells, 2,640,000 and hæmoglobin, 35 per cent. We so strongly suspected sarcoma, even though the sections failed to show it, that I decided to explore, and this was done October 5, 1920. A tourniquet was placed just above the knee to prevent dissemination of sarcoma cells, if found. An enormous bulging overgrowth of granulation tissue was removed with the fingers and curette down to the bone. There was much slender striæ of bone formation, perpendicular to the shaft, throughout this, but the sarcomatous tissue was not encountered until the wound had been opened to the posterior mesial aspect of the tibia, where it was found in abundance. Fresh operative toilet (gowns, gloves, instruments, and dressings) was promptly made, an additional tourniquet placed high upon the thigh and a mid-thigh amputation done between the tourniquets.

Pathological report, Dr. R. V. Lamar: "Large round-cell sarcoma, apparently arising from the periosteum of the upper portion of the tibia and invading muscles and connective tissue (not the bone) upward into the popliteal space, extensive hæmorrhage, some necrosis, wide-spread infection (staphylococcus aureus) of the soft parts. Also osteomyelitis of the tibia way down the shaft below the limit of the tumor. Staphylococcus here also."

The immediate convalescense was satisfactory, with marked improvement in the general condition, and she was discharged from the hospital on the twelfth day.

Four months later there was a questionable infiltration of the left lung which was definite after a lapse of 2 months more—thus X-ray April 15, 1921: "Areas of density in the left base and right upper portion of lower (left) lobe—at least suggestive of

[1] Read before the Southern Surgical Association, Pinehurst, North Carolina, December 13-15, 1921.

recurrence of sarcoma in lungs." She escaped from our observation after this and the next we heard was of her death August 12, 1921, 10 months after amputation, 13 months after first symptom. The family, upon interview, gave history of her last illness which indicated that in all probability it was pulmonary metastasis.

CASE 2. (Private.) Wilhenford Hospital No. 7392, admitted March 15, 1921. Miss S., age 12, white, had sarcoma of periosteal origin of the large round-cell type of left tibia. Family and past history were negative except for three miscarriages by her mother. She first noticed "growing pains" in the left tibia during February, 1920. Swelling appeared about July 1, 1920, and following this she began to have attacks of "hard pains" in the leg with drawing of the toes, duration 2 to 3 days. Some relief was obtained by hot moist applications. No loss of function except during the attacks. No history of trauma or of any serious illness. She was given antisyphilitic treatment with a presumptive diagnosis of syphilitic periosteitis, from July, 1920, until early in January, 1921. During the latter part of January she developed gonorrhœa for which she was treated by Dr. F. X. Mulhering with whom I saw her in consultation relative to the leg about March 1, 1921. Blood Wassermann was negative. Leucocytes, 13,000 and hæmoglobin, 60 per cent. Chest, negative. Examination of the leg as noted below except that the growth was not quite so large, its progress had been very slow. It was diagnosed as probable sarcoma and careful study of an X-ray taken in December rather confirmed this opinion, and operation was advised. They procrastinated however, until, several days before admission to the hospital, there was a rather sudden and rapid increase in size which served to hasten her to the hospital.

Examination March 16, 1921. There is a fusiform swelling of the left tibia, mid and upper thirds, the largest diameter, 2 inches, at about the junction of these thirds. No tenderness, no loss of function, no involvement of knee or other joint. No elevation of surface temperature. It is quite indurated and apparently covered with bone. No pulsation. General examination otherwise negative. X-ray at this time taken in the University Hospital was reported as probable sarcoma of periosteal origin. There were two superimposed layers of bone (?) above the shaft with fine striæ of bone formation perpendicular to the shaft. X-ray of the chest was negative. No other bones taken.

Operation March 19, 1921. A tourniquet was placed just above the knee, the tumor explored and found to be sarcoma, verified by frozen section. Fresh operative toilet and a mid-thigh amputation done without removing the lower tourniquet. Convalescence was uneventful and she was discharged 3 weeks later.

The tibia was dissected out and the growth found to be fusiform, extending entirely around the tibia but thinnest on the posterior aspect. It was apparently perfectly encapsulated with no invasion into the surrounding tissues or into the bone, seemed rather to be superimposed upon the shaft of the tibia. Upon splitting it a small abscess was found in the medullary cavity with early necrosis of the canal mid-way the length of the tumor and staphylococcus aureus upon culture.

Subsequent history to date is uneventful, no evidence of recurrence local or otherwise. She has grown rapidly and added considerable weight.

CASE 3. University Hospital No. 23341, admitted August 3, 1921. Julia M., age 20, negro, with periosteal, large round-cell sarcoma. Family and past history negative. No serious illness. Present illness began 3 months ago as a small lump on the anterior surface about mid-way the left tibia. Growth gradual for 2 months, but quite rapid during the past month, and she has had to use a strong stick in walking. Following the use of hot applications to try to lessen the swelling, it became ulcerated. She has never had any pain. Loss of weight has been rapid during the past month. Never any trauma.

Examination negative except as follows: the left inguinal glands and those in Scarpa's triangle were a trifle enlarged. There was a fusiform swelling of the middle third of the left leg, about three times the size of the right. The toes were dropped and the foot somewhat inverted, and a small ulcerated area over the anterior surface of the tumor. Some elevation of surface temperature but no tenderness upon palpation or manipulation, the latter reveals false motion in the region of the tumor. The growth is soft and nowhere suggests bony covering. Temperature upon admission was 102° and showed a daily range from 100° to 104°, the pulse rate, 110 to 135. Urine, blood and blood Wassermann were negative. Hæmoglobin, 90 percent.

X-ray August 4, 1921, reported "Osteosarcoma invading the middle portion of the left tibia. Fracture, transverse of the left fibula at the junction of the mid and lower thirds with callus formation and angulation." A small section was taken from the ulcerated area which was immediately cauterized with the electrocautery, this was reported as sarcoma.

Operation August 5, 1921. Dr. G. N. Coker, resident surgeon. Mid-thigh amputation. Convalescence was uneventful except for a low grade wound infection with bacillus pyocaneus. She was discharged September 15, with wound healed and general condition good. Temperature dropped to normal immediately after operation, the pulse rate more slowly.

Pathological report, Dr. R. V. Lamar: "Large round-cell sarcoma apparently periosteal origin and beginning at about the junction of the mid and lower thirds of the left tibia mesially, invading the bone and leading to fracture, and invading much more the soft tissues, extending out to the skin with ulceration, infection and sloughing: down to the inner malleolus and upward to above the middle of the tibia. Many mitotic figures. Much fine intercellular lime deposit with very early formation of new bone

extending perpendicularly." The lower portion of the tibia showed dense infiltration downward about 2 inches and below this, the growth extended subperiosteally to the lower border of the internal malleolus. The tibia above the fracture showed extensive necrosis and infection (staphylococcus aureus). The fibula was not invaded and the site of fracture seemed to be healing with normal callus. Recent interview and examination shows her still in apparently good condition.

SUMMARY

1. The author reports three cases of large round-cell sarcoma, periosteal origin, associated with infection and necrosis of bone.
2. All females, two white, one negro.
3. Ages, 14, 12, and 20 years respectively.
4. Left tibia in each case.
5. No history of trauma or serious illness.
6. Local pain in two, none in the other.
7. Staphylococcus aureus infection in each.
8. Rapid pulse and rather high fever in two, none in the other.
9. Treatment, mid-thigh amputations.
10. Results, one dead, and two living free from signs of recurrence, local or elsewhere, to date.

CASE 1, developed in the hospital under our observation and we feel reasonably sure therefore, that the osteomyelitis preceded the sarcoma.

CASE 2, we questioned which preceded although we did not suspect the infection and necrosis or abscess prior to operation but found it upon dissection of the specimen. Might the history, however, of attacks of pain—"growing pains" for several months preceding the development of the tumor—suggest infection or abscess as the original?

CASE 3, gave an indefinite history and showed a well advanced growth when we first saw her. The specimen was interesting in that there was a rather sharp line of demarcation at the site of the pathological fracture of the tibia—extensive osteomyelitis of the shaft above, whereas below, there was wide-spread invasion by the sarcoma of bone and soft parts, extending downward even to the internal malleolus.

NOTE.—August 21, 1922. Cases 2 and 3 are living and apparently in excellent health, free from any evidence of recurrence, at this time.

UTERUS SEPTUS DUPLEX, WITH FULL-TERM TWIN PREGNANCY

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ANOMALIES in uterine formation, with subsequent pregnancy, are usually interesting to report and that the "double" type of uterus has some clinical significance goes without saying. The case reported below is unique, as a search of the literature for some years back does not reveal one of uterus septus duplex, where pregnancy took place in each half and went to term with living babies.

The various textbooks on obstetrics and gynecology contain a few pages on this subject and its etiology and anatomic types. Before going further allow me to review in brief a few of these points. Embryologically the vagina and uterus are formed by the fusion of the two muellerian ducts, and this fusion takes place from below upward. In anatomical studies of actual cases, it has been found that failure of this normal fusion has resulted in several varieties of abnormality, some little and some very greatly divergent from the normal condition. For instance, we get the case of double vagina, with normal uterus; the double vagina and cervix but single uterine cavity; the normal vagina and cervix but uterine cavity divided by a central septum; the uterus, two distinct portions, only joined low down at cervix (uterus diadelphus); the well developed uterus, with a rudimentary horn, and so forth, through other anatomical malformations.

In many of these cases no other abnormality is present and the local condition is only discovered by accident, since the patient is not cognizant of an unusual condition. Some degree of lack of fusion of the muellerian ducts is not uncommon as shown by the number of cases reported in journals as well as from my personal observation, and I wonder if it cannot account for some of the unusual obstetrical and gynecological conditions we meet from time to time. One book mentions that this may be the factor in a case of regular menstrual flow, accompanied by known pregnancy; the menstrual blood coming from the unimpregnated portion of the uterus; it may account for excessive menstruation at regular periods. Some of the aborted pregnancies in the early months may be due to the impregnation in a rudimentary portion of such a uterus and it may account for some of the other abnormalities. Impregnation with normal delivery has taken place with cases of such congenital abnormalities and the double vagina or "double" uterus only discovered later during some operation or on pathological examination of the uterus. Cases have been reported where a full-term pregnancy has taken place in one half and an undeveloped embryo or fœtus found in the other portion. One case is on record where a twin pregnancy had taken place in one horn of a bicornuate uterus and had calcified and remained for 20 years before discovery. It has been said that twin pregnancy may in some cases be due to this anomaly; each portion of the uterus being impregnated separately or by superfœtation but not in the same uterine cavity. My case seems to give proof of this. Before giving case history let me say that I regret exceedingly, owing to a preventable error, it was not determined in this case whether the vagina was single or double.

Mrs. Z., I-para, age 30; birthplace, Russia. Past and family history as far as obtained showed nothing important. The entire history in this case was unsatisfactory as neither patient nor any member of her family that visited her could speak English and the little obtained came through interpretation.

Prenatal history. Last catamenia not known but husband said she was due at this time. Patient was under midwife's care until 2 hours before entrance, when seen by Dr. Paul Jakmauh who referred her at once to the hospital. General œdema seemed to have started about 3 weeks ago, and patient became seriously ill with symptoms of impending convulsions a few hours before Dr. Jakmauh was called.

Physical examination shows large woman, with general œdema over entire body, weighing at least

300 pounds. She could not speak English but kept putting hand to head as though suffering from headache. Patient dull and semi-stuporous. Œdema more marked in face, limbs, and abdominal wall; all these regions more œdematous than the writer had ever seen. Tongue was covered with heavy brownish coat and thickened. There was a slight systolic murmur at apex transmitted upward; the borders of heart were not made out clearly. Pulse 90 and synchronous with heart beats.

The lungs showed nothing abnormal but breathing was of sterterous type and made examination difficult; no œdema of lungs was found.

Blood pressure: systolic, 196; diastolic, 140.

The abdominal walls were œdematous and a large uterus, consistent with full term, made out; no uterine contractions; fluid wave with question in abdominal cavity. Vulva very œdematous but no vaginal examination made. No fœtal parts or heart made out.

Operative record showed pre-operative diagnosis, toxæmia of pregnancy with impending convulsions.

Postoperative diagnosis, toxæmia of pregnancy plus uterus septus duplex.

Anæsthesia, ether, Sister Thecla; assistant, Dr. Nelson.

Operation. Through a median low incision the peritoneal cavity was opened with evacuation of large amount of clear, ascitic fluid; the uterus was opened in the median line in the lower segment; the membranes presented and ruptured and fœtus was delivered; cord clamped and cut and baby given to assistant; uterus emptied of placenta, membranes and clots. It was then noticed that uterus did not collapse as in the normal case after delivery of contents and exploration showed the uterus to be enlarged to right of present uterine cavity to about size of full-term pregnant uterus. I first thought I had to deal with a large fibroid and after suturing the uterine wound in layers in the usual way, I proceeded to remove a supposed fibroid. On cutting down to enucleate I opened into a cavity and membranes presented which were ruptured and disclosed a fœtus; child was delivered and cord clamped and cut and baby given to assistant. This uterine cavity was emptied of second placenta and membranes, and examination now showed a septum about one-half inch thick running from fundus down through cervix and completely dividing uterus into two distinct halves, though externally no point of division was noticeable. The second uterine cavity was sutured in layers without disturbing septum. Patient had been given ergotin subcutaneously as is the custom in our cases and did not bleed more than usual. All bleeding was controlled and the peritoneal cavity sponged clean and the peritoneum and abdominal wall closed in layers in usual way. The patient was returned to bed in good condition and made good operative recovery. Both babies in good condition: first weighed 6 pounds; second 6⅞ pounds; both females.

Postoperative record in brief: Toxæmic condition never seemed to improve and patient remained in semi-stuporous condition, running constant high blood pressure. During this time patient had some urinary suppression and catheter specimens showed constantly much pus, blood cells, and casts. On third day there was a small breaking down at lower end of incision with evacuation of seropurulent material. This cleared up on ninth day. During this time patient had no vomiting and kept down liquids; bowels moved with enemata and cathartics. On eleventh day postpartum patient had a typical uræmic type of convulsion and died in about 1 hour. No permission for autopsy was obtained.

CHOLECYSTENTEROSTOMY FROM AN EXPERIMENTAL STANDPOINT[1]

By GATEWOOD, M.D., Chicago
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AND
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THE possibility of making an anastomosis between the gall bladder and some part of the gastro-intestinal tract was suggested almost as early as the operation of cholecystotomy. Nussbaum (1) is generally credited with first suggesting such an anastomosis. He did not suggest the present operation but stated that in cases where the flow of bile into the intestine was no longer possible, the question of an artificial stoma made by some adhesion between the liver and the bowel was one to be considered. In 1880 or 1881 von Winiwarter (2) performed the first operation of this type. He sewed the gall bladder and the ascending colon together and fastened them in the abdominal wound. Two attempts to establish connection by means of a trocar failed. Later a loop of small bowel was fastened to the gall bladder and a tube inserted. Four operations were required to close the fistula which followed, so that the patient had undergone at least half a dozen operations before the necessary anastomosis was completed.

In 1884, Gaston (3), of Georgia, experimenting upon dogs, fastened the surfaces of the gall bladder and duodenum together by means of a single elastic suture and relied on the formation of a fistula as the suture gradually passed into the bowel. In some of his dogs he found the fistulous opening persisted 3½ months after the operation in spite of the fact that the common duct was not ligated.

Harley (4) established a communication by applying a corrosive paste to the surfaces of the two viscera and rapidly uniting them by means of suture.

Golzi (5) opened both the gall bladder and the bowel and united them by two rows of sutures. This method is practical and safe and has served as a basis for subsequent operations.

In 1892, Murphy (6) advocated the use of his button instead of the sutures. This method was generally adopted for a time but has now been practically abandoned, although it can be used to advantage in well-selected cases.

Cholecystenterostomy in one stage was first done in man by Monastyrsky (7) in May, 1887, and about a month later by Kappeler (8). Both dealt with cases of carcinoma of the head of the pancreas. In each instance the gall bladder was united to the small intestine by means of two rows of sutures.

Mayo-Robson (9), in 1889, united the gall bladder to the colon with apparently good results. In 1902, Radsiewsky (10) was able to collect 56 cases of anastomosis of the gall bladder to some portion of the gastro-intestinal tract. Mayo-Robson (11), in 1909, reported 62 cases of cholecystenterostomy. In 49 of these there was benign occlusion of the common duct (chiefly interstitial pancreatitis) and in 13 the obstruction was due to malignancy. Of the former, 47 made a complete recovery, while of the latter only 7 survived the operation. In 1913, Kehr (12) reported that he had performed more than 60 cholecystogastrostomies with excellent results.

Although the establishment of a fistula between the gall bladder and some portion of the gastro-intestinal tract has become a recognized operation with fairly definite indications, there is still considerable difference of opinion as to what part of the canal should be used. Most men of experience prefer the duodenum as this more nearly restores normal physiological relations. Such an anastomosis, however, is not possible in many cases on account of adhesions, or, perhaps, the presence of a tumor. Where it is necessary to take some other portion of the gastro-intestinal tract, the stomach, jejunum,

[1] Read before the Chicago Surgical Society, April 1, 1921.

ileum or colon may be used. Spontaneous fistulæ between the gall bladder and the colon have been found at autopsy and at operation in cases of cholelithiasis. Some of these cases have apparently done well for a considerable time. Mayo-Robson performed his first cholecystocolostomy upon a woman with a tumor in the gall-bladder region. The duodenum was inaccessible on account of adhesions and the gall bladder was, therefore, united with the hepatic flexure of the colon. Although a fistula persisted for a few weeks the patient made a good recovery and was living 4 years later. In summarizing his experience, he stated that although the anastomosis with the colon had acted very well, he no longer thought it the safest operation because of the possibility of suppurative cholangeitis. This seems to be the general opinion of the men who have had the largest experience with this type of operation.

Cholecystogastrostomy, first reported by Wickhoff and Angelberger (33), then for a time advocated only by the French (Perrin, Jaboulay, Terrier, and Lejars), seems to be gaining in favor at the present time. Hans Kehr, in urging it, claims that there is less danger of infection and more accessibility. He states that most of his patients never vomited and soon had a good appetite. He believes that the danger of an ascending infection is present in any anastomosis, but that the stomach is least likely to give trouble. In more than 60 cases in the 10 years prior to 1913, he noted liver infection in but one instance.

Many surgeons have hesitated to anastomose the gall bladder to the stomach because they have feared that the bile might disturb the chemistry of digestion. The older physiologists (Claude Bernard, Schiff, and Hammerstein) showed that bile *in vitro* delayed digestion. This was believed to be due to a precipitation of pepsin and peptones. These men taught that bile in the stomach had a harmful influence upon the organism. That quite different conditions prevail in natural digestion was early shown by A. Dastre (13) and Oddi (14). Dastre in 1880–1883 gave bile to dogs at intermittent periods, either by mouth or by gastric fistula, and showed that the animals did well under these conditions. He also showed that, when the bile was introduced into the stomach during digestion, the gastric contents remained acid and contained pepsin and peptones. Oddi, in 1887, both by feeding experiments and by anastomoses showed that in dogs, bile entering the stomach did not disturb the digestive process nor interfere with the general health of the animal. Paterson (15) states that in gastrojejunostomy the total gastric acidity is reduced 30 per cent, due partly, he believes, to the entrance of bile and pancreatic juice and partly to the diminution of the total chlorides secreted by the gastric mucosa. Employing dogs, Wiedemann (16) made fistulæ of the stomach and of the bowel at the junction of the jejunum and ileum. Control tests were made for 4 weeks, after which cholecystogastrostomy was performed. He found that on a milk diet, the addition of bile did not reduce the acidity of the stomach contents. There was some decrease in the splitting of albumin due perhaps to the absence of the usual regurgitation of pancreatic juice with the bile. The amount of undigested food in the intestinal contents was found to be less. Masse (17) kept dogs with cholecystogastrostomies alive for 9 months or more and reported that they remained perfectly healthy. Cannac (18) has confirmed these observations.

A number of men (Monprofit, Kausch, and Speed), owing to the accessibility of the jejunum, have advocated its use for anastomosis. Pendl (24) first performed a cholecystenterostomy through a slit in the mesocolon (cholecystenterostomy retrocolica). Krause (25) then combined a cholecystenterostomy with an entero-anastomosis. Krukenberg (26) turned the fundus of the gall bladder 270° on its long axis, thus converting it into a screw-shaped passage. Monprofit (27) sectioned the jejunum and sutured the end of the distal part to the gall bladder, the proximal end being anastomosed to the side of the distal portion, thereby producing a Y-shaped affair. Kausch (28) modified Monprofit's operation by forming a narrow passage out of that part of the bowel attached to the gall bladder.

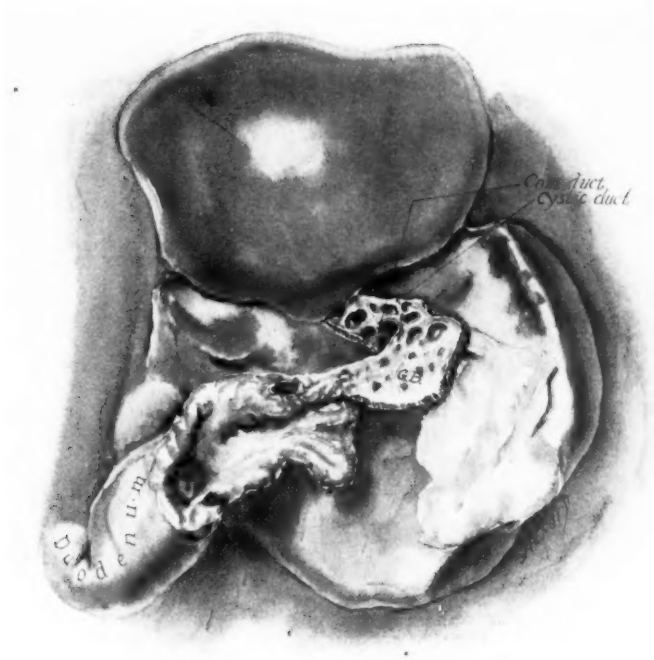

Fig. 1. Cholecystoduodenostomy (Dog No. 34). The wall of the gall bladder and the ducts are greatly thickened. Notice the tendency to rugæ formation. (This dog was killed 66 days after operation.)

He inserted a rubber tube and narrowed the bowel over it by a continuous stitch. Von Bardeleben (quoted by Kausch) attempted to lead the gall bladder obliquely through the bowel wall as in the Witzel method of gastrostomy. These modifications on the whole are too time-consuming for clinical purposes and have not been of sufficient value to warrant their general adoption.

Of far more importance than any digestive disturbance is the likelihood of an ascending infection of the bile passages and liver, owing to the new avenue of entrance for organisms from the gastro-intestinal canal. The ampulla of Vater is an effective barrier to all foreign bodies, such as bacteria-laden food particles. Netter (19) and others have shown that the portion of the common duct next to the ampulla contains micro-organisms, although the gall bladder and liver apparently are normally sterile. The fact that the micro-organisms circulating in the blood are eliminated by the liver (Biedl and Kraus, 20) leads one to conclude that the bile passages are so constructed that they can harbor bacteria at least for a time, without suffering any marked pathological change. A different state of affairs is produced, however, when a direct communication is established between the gall bladder and the gastro-intestinal canal. It is here that the character and number of micro-organisms at different levels of the intestinal tract seem to be factors in the relative safety of the various anastomoses. It is generally known that the number of bacteria increases from the duodenum down to the sigmoid. It is also well known that the gastric juice exerts a destructive influence on bacteria, but many are unaware that the count in the stomach is higher than in the duodenum (Gilbert and Dominici, 21). The colon bacillus, which is

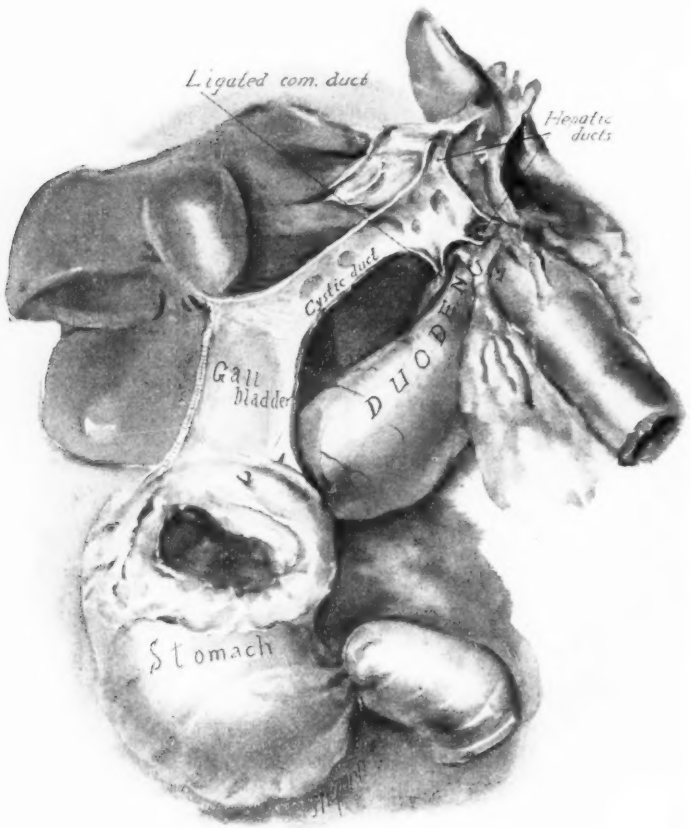

Fig. 2. Cholecystogastrostomy (Dog No. 8). The dilatation of the cystic duct and shrinkage of the gall bladder are quite evident. A thread is still attached at the line of anastomosis, but there is no evidence of ulcer formation. The stump of the common duct has atrophied. (This dog was killed 8 months after operation.)

one of the chief offenders in inflammations of the bile tracts, is, however, less common in the stomach and duodenum and rapidly increases in numbers from the duodenum down. One of us (22) has found that in fasting dogs organisms are constantly present in both the stomach and duodenum; also that streptococci are relatively infrequent and colon bacilli are not at all common in the stomach though frequently found in the duodenum.

Among the earliest clinicians to recognize the danger of ascending infection following cholecystenterostomy was Dujardin-Beaumetz (23) who noted in one case the clinical picture of "intermittent hepatic fever" described by Charcot. Kehr also has advised that the use of the operation be greatly limited on account of the danger of bacterial infection. Murphy (6), in 1892, reported that in experimental work with his button, a flap of mucosa covered the fistulous opening, allowing the bile to flow into the intestine but preventing the intestinal contents from escaping into the gall bladder. Nevertheless, isolated cases of infection have been reported following the use of the button and various other operations advocated as a result.

The first piece of experimental work done to determine the changes in the liver and bile passages following cholecystenterostomy was done by Radsiewsky (10). He doubly ligated the common duct, cut between the ligatures, and united the gall bladder to the duodenum. Five of his dogs survived the operation and were killed from 30 to 75 days later. From his experiments he drew the following conclusions: (1) dilatation and hypertrophy of the bile passages occur; (2) there is a thickening of the mucosa resulting from new gland and lymphatic follicle formation; (3) mild desquamative catarrh of the intrahepatic bile passages occurs; (4) invasion by bacterial flora into the liver parenchyma results. He believed that cholecystenterostomy itself carried with it little likelihood of infection of the bile passages and liver, but that invasion of the gall bladder with retained intestinal contents was a distinct menace and was likely to be followed by an ascending infection. Hubicki and Szerszynski (29) operated on seven dogs, some of them by Monprofit's and others by Krause's method. At the end of a year, they found suppuration in the bile passages and liver in four of their animals. They believed that the negative results Radsiewsky obtained in some of his animals were due to the fact that they were not allowed to live long enough. Mocquot (30), in 1913, reported the findings in one dog with a cholecystoduodenostomy killed a year after operation and in another dog with a cholecystogastrostomy killed at the end of 4 months. His bacteriological findings in the two cases were practically the same, the livers being sterile, the common ducts containing a few organisms and the gall bladders many. Microscopic examination showed the bile passages and the liver in the duodenostomy practically normal except for a slight increase in the connective tissue. In the gastrostomy there was a marked increase in the connective tissue.

The results obtained experimentally would at first hand seem to contradict those obtained clinically. The large series of cases of Mayo-Robson (11), von Bardeleben (31), Kehr (12), and others with few reported liver infections has placed the operation among

Fig. 3. Cholecystoduodenostomy (Dog No. 31). Note numerous round worms extending into the small branches of the hepatic ducts. The pancreas was swollen in this case. While the liver showed no gross abscesses, microscopic sections showed areas of necrosis and fatty degeneration. (This dog was killed 6 months after operation.)

those regarded as relatively safe. On the other hand, evidence that no infection occurred is incomplete in many cases. Often the patients died of malignancy soon after the operation. In cases of chronic interstitial pancreatitis, the persistence of the stoma might be questioned. No doubt the bile resumes its normal course as soon as the pancreatic obstruction is relieved. It is probably then a question of but a few weeks or months before the fistulous opening has closed. (This is what happened in Dog 8 in our experiments.) The severity of the infection also may be a factor in its clinical recognition. A low-grade hepatitis may be present for a long period without producing marked symptoms and it is only by a careful microscopic examination that the amount of damage done to the liver can be determined. This was demonstrated repeatedly in our experiments and has been shown by Graham (32) in his clinical work.

It is still an open question as to what type of operation is least likely to be followed by an ascending infection of the bile passages and liver. It was in the hope of obtaining a little light upon the relative safety of the various gall-bladder anastomoses that our series of experiments was performed

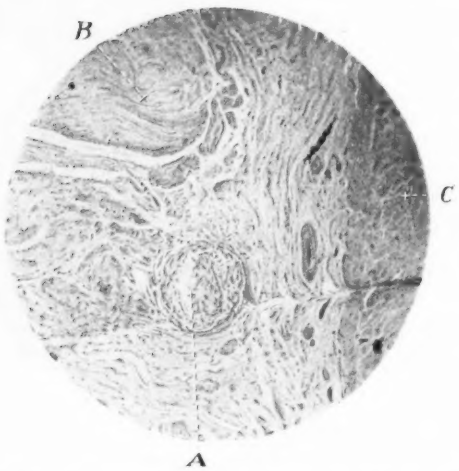

Fig. 4. Microphotograph—low power—to show line of union between stomach and gall bladder. (Dog No. 18.) Note lack of inflammatory reaction about suture. (This dog was killed 5 months after cholecystogastrostomy.) *a*, Cross-section of thread; *b*, muscularis of stomach; *c*, gastric mucosa.

and while the results may not be conclusive, we believe they demonstrate some facts of clinical importance.

METHOD

Our experiments have consisted in making 42 anastomoses in dogs. The animals, which had been starved for 14 hours, were operated upon under ether anæsthesia. A high right rectus incision was made. Cultures were made from the gall bladder, liver, and from the portions of the gastro-intestinal tract used for anastomosis. Grossly, all livers appeared normal at the time of operation, and sections taken in a number of instances were entirely negative. The common duct was then doubly ligated and cut, except when otherwise stated. The gall bladder was united to the stomach or intestine by two rows of continuous Lembert sutures of silk or linen, the upper row uniting the serous membrane and the inner passing through all the layers. Great care must be taken with hæmostasis as several fatalities occurred from hæmorrhage into the gall bladder. The abdominal incisions were all closed without drainage.

In the first six dogs the common duct was not obstructed and somewhat to our surprise the anastomoses practically closed just as a gastro-enterostomy stoma frequently closes when the pylorus is unobstructed. In one case (Dog 13) the common duct was simply ligated with a piece of heavy thread. Thirty-two days later the lumen of the duct had been restored and the cholecystogastrostomy stoma was so small that only the finest probe could be passed through it. In all other cases the same technique was employed; that is, the common duct was isolated, doubly ligated and divided, allowing the two ends to retract. In some instances a portion of the duct was resected.

Of 20 cholecystogastrostomies, 17 duodenostomies, and 5 colostomies, 2 gastrostomies, 1 duodenostomy, and 1 colostomy died either during or immediately after operation. Four cholecystogastrostomies, a like number of duodenostomies, and 3 colostomies were killed or died on account of peritonitis.

Owing to the length of this paper, protocols of the individual experiments have been omitted and a simple statement of the results given. Cultures made from the gall bladder were sterile, both in aerobic and anaerobic cultures, in 41 of the 42 dogs. A few colonies of the staphylococcus albus were found in one instance — almost certainly a contamination as this organism is usually found in the skin. Cultures made from the liver were sterile in 32 out of 37 examinations. (No cultures were made in 5 dogs.) Staphylococcus albus in pure culture was found in two instances and various contaminations, mostly hay bacillus, were found in the other three. It is quite probable that all livers were sterile, but that they were contaminated by using the same knife which was employed in making the peritoneal incision. Cultures were uniformly negative after taking the precaution to employ a new knife for the removal of the tissue.

Four of the cholecystoduodenostomies were killed at 10, 36, 66, and 300 days. Seven stomach anastomoses were killed at 2, 6, 8, 35, 75, 129, and 166 days, and three cholecystocolostomies at 1, 2, and 5 days. While it was the purpose of our experiment to keep the dogs much longer, this was not practical on

account of the housing conditions, and because some of the dogs developed distemper. *In every instance, whether the animal lived 1 or 300 days and regardless of the viscus employed for the anastomosis, the gall bladder was infected.* Grossly, in all cases living more than a month, the mucosa was thickened and white (Fig. 1). In the older cases, the gall bladder became narrowed and the stump of the common duct which was dilated in the earlier cases atrophied so that a probe could scarcely be passed down it. No evidence of ulcer formation was seen at the line of anastomosis although the threads were found loosely attached in many of the older cases (Fig. 2). A number of the older dogs died of worms, and round worms could be found obstructing small intrahepatic ducts which would barely permit of their entrance (Fig. 3). Hairs were found in the smaller hepatic ducts a number of times.

Microscopically, the mucosa of the gall bladder was inflamed, thickened, and frequently there was a tendency to villous formation. The mucosa and submucosa contained collections of round cells, and the muscularis was infiltrated in most of the cases. The line of anastomosis usually was a narrow strip of scar tissue. Sometimes, the silk or linen suture could be demonstrated, usually with very slight reaction about it (Fig. 4). The findings in the liver varied greatly depending upon the amount of cholangeitis. In some cases there was nothing more than a slight cloudy swelling. In one cholecystogastrostomy killed 129 days after operation, there were no changes noted in the liver in spite of the fact that both colon bacilli and other organisms were recovered bacteriologically (Dog 14). In all of the other dogs which survived any great length of time, a definite increase in the connective tissue about the ducts occurred, and in some cases this was quite marked as early as 66 days (Fig. 5). Although a round-cell infiltration was frequently found in the interlobular septa, no definite abscess formation was found except in two dogs. (One duodenostomy killed in 10 days showed some necrosis in the center of the lobules. Another killed at the end of 300 days had developed an abscess between the liver and the gall bladder.) In no instances in our series were multiple intrahepatic abscesses found.

Fig. 5. Microphotograph—low power—to show marked increase in connective tissue and central necrosis of lobules. (Dog No. 34.) (This animal was killed 66 days after cholecystoduodenostomy.) *a*, Connective tissue between lobules; *b*, bile ducts; *c*, liver parenchyma.

Bacteriologically, the gall bladders contained many and varied organisms, including chiefly the colon bacillus, the staphylococcus, and numerous anaerobes. Yeasts and fungi were not uncommon. The livers in the cholecystogastrostomies were sterile up to 35 days. The duodenostomies killed at 10, 36, and 66 days likewise had sterile livers, but the dog killed at 300 days had a colon and staphylococcus infection in the liver cultures. Two cholecystocolostomies killed 1 and 2 days after operation had infected gall bladders. The other three cholecystocolostomies died of infection, or were killed *in extremis*. Fæcal matter was found in the gall bladder in every one of these cases, and it seems almost certain that all colostomies would sooner or later develop hepatic infection.

It is very difficult to prevent leaks and peritonitis when the colon is employed, while no difficulty was experienced with the other anastomoses. This I believe is due in part to the peculiar nature of the flora of the colon and partly to the short large bowel of the dog which prevents anastomosis without tension.

CONCLUSIONS

From the foregoing experiments performed upon dogs in which the gall bladder was anastomosed to the stomach, duodenum, and colon, the following conclusions may be drawn:

1. The gall bladder invariably becomes infected regardless of the viscus used for anastomosis.

2. There is little, if any, difference between the stomach and duodenum in the matter of rapidity of infection.

3. The colon is not the portion of the gastro-intestinal tract to be chosen by preference. The immediate dangers of peritonitis are much greater, and probably liver infections would occur earlier than when the upper part of the gut is used.

4. All livers become infected sooner or later if the method employed in our experiments be followed.

5. Cholecystenterostomy, from an experimental standpoint, is not an operation to be recommended for use except in well-selected cases, such as carcinoma of the pancreas where the temporary comfort of the patient is paramount, or irreparable common duct obstruction.

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UNUSUAL CASE OF SARCOMA OF THE MEDIAN NERVE

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THE patient was 40 years of age, American, and unmarried. She had been well until about 5 years ago. At that time she noticed a small swelling in the anterior surface of the right forearm, midway between the wrist and elbow, which was not painful or tender, and which remained practically constant in size. Five weeks before admission to the hospital, her right forearm began to swell in the region of the tumor, and this continued until the circumference of the right forearm was half again as large as the left and the patient suffered considerably from pain in the right forearm and hand, especially at night.

Physical examination showed nothing abnormal in chest or abdomen. The kidneys were normal as to microscopic examination and functional test. Blood Wassermann test was negative. Leucocytes 9,500, hæmoglobin 70 per cent. There was very slight diminution of function over distribution of median nerve but not sufficient to be noticed by the patient.

Operation was done May 31, 1921. An incision was made along the anterior aspect of the right forearm, exposing the flexor tendons. There was a large mass about 8 inches in diameter, which was apparently connected with the median nerve. The median was divided at either end of the tumor, leaving a gap of about 9 inches of nerve, and the mass removed.

The following is the report from the pathological laboratory: Grossly the specimen is a sausage-shaped, symmetrical mass about 15 centimeters long and averaging 4½ centimeters in diameter. It was rather firm in consistency and of a pinkish-grey color. From the upper extremity is seen projecting the nerve trunk, the sheath of which evidently forms the capsule of the tumor. The gross appearance of a cross section through the middle of the tumor mass shows irregular circular markings, suggestive of capsules of nerve bundles into which tumor cells have penetrated.

Microscopic slides were made from sections of the lower pole of the tumor mass, from the middle and also from the nerve trunk emerging from the tumor. Microscopic examination of the sections from the lower pole gave a typical picture of the so-called neurofibroma, and its close association with the nerve sheath leads one to the conclusion that the original tumor arose from this structure. Examinations of the sections from the central portion of the tumor shows it to be made up of very rapidly growing cells, irregular in shape and size with definite vesicular nuclei and many typical mitotic figures Giant cells, both mononuclear and multinuclear, are to be found scattered about throughout the field. The predominating cell is of the spindle type. Dilated capillary vessels with distinct walls are widely distributed throughout all the sections. Preparations through the nerve trunk show in a majority of the bundles a marked fibrosis with atrophy of the nerve fibers. In some of these there was marked infiltration of rather regular spindle cells with oval vesicle nuclei and showing but few mitotic figures. This is evidently an extension of the tumor mass up through certain nerve bundles.

Histological diagnosis: A rapidly growing, irregular, spindle-cell sarcoma, originating in a neurofibroma.

The wound healed by primary union. It was surprising to see the amount of function still present in the flexor tendons,—apparently through the ulnar distribution to the flexor profundis digitorum.

August 2, 1921 (5 weeks after operation), patient returned with a similar swelling at the site from which the tumor had been removed. Thinking it might be a blood clot, a small incision was made into the mass,— but it was entirely a return of the sarcoma.

Amputation of the arm was advised but the patient refused, and she was treated with X-ray and radium. The tumor continued to enlarge and one month later she was again urged to consent to an amputation of the arm, but she wished to interview relatives in Cleveland, Ohio, before consenting to another operation, and was referred to Dr. George W. Crile.

She received additional X-ray treatments while

Fig. 1. Gross specimen removed.

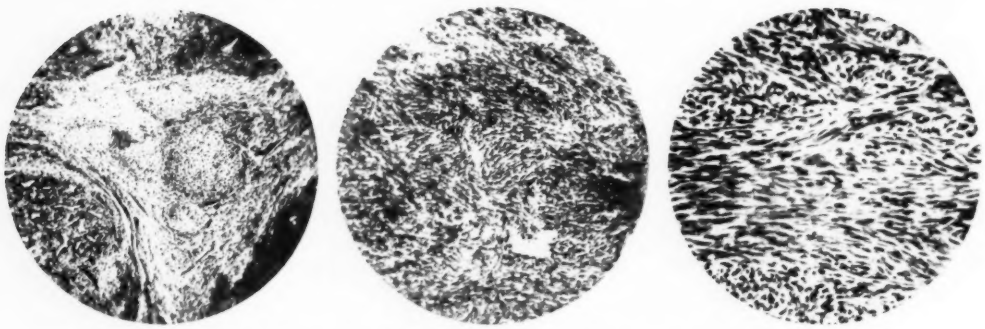

Fig. 2. Photomicrographs of specimen showing spindle-cell structure of tumor.

under Dr. Crile's care but the progress of the growth was not checked, and on October 17, 1921,— a little over 3 months after the first operation,— the arm was amputated at its middle, by Dr. Crile.

Frozen section diagnosis at that time was mixed cell sarcoma.

In a review of the literature extending back several years, there have been found only two cases of neurosarcoma reported. In one paper, published by McArthur in the *Surgical Clinics of Chicago* for February, 1920, there is described a neurosarcoma of the posterior tibial nerve which was completely removed at operation but which required a subsequent removal of the retroperitoneal lymph nodes where metastases from the nerve tumor occurred. Max Minor Peet, in the *Journal of the Michigan State Medical Society* for July, 1917, reports a case of spindle-cell sarcoma arising in a cavernous lymph and hæmangioma of the musculospiral nerve. In this case the tumor was removed, with part of the nerve, and the nerve ends sutured. Two months after the operation there was no recurrence of the growth, and the patient had excellent use of the arm and hand except for a wrist drop.

A number of the textbooks on pathology mention neurosarcoma, and L. Aschoff in his *Pathologic Anatomy* for 1921 characterized true neurosarcomata as being of very rare occurrence. Keen's *Surgery* reports sarcoma occurring in the posterior tibial, popliteal, and peroneal nerves.

The case we are reporting is interesting for the following reasons: (1) its unusual size; (2) its prompt recurrence; (3) its marked resistance to X-ray and radium; (4) the rather positive evidence of its developing from an innocent neurofibroma.

HYDATID CYSTS OF THE HEART, WITH REPORT OF CASE

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I AM able to report this case through the courtesy of Dr. A. F. Wagner, in whose official practice, as coroner's physician to the city of Los Angeles, it occurred.

Case J. G., Frenchwoman age 36, found dead.

Postmortem, January, 1921. Heart: hydatid cyst of the right ventricle 5 centimeters in diameter. Typical laminated cyst wall. No daughter cysts or scolices. Lungs: right lung — four cysts size of walnut inner side lower lobe in substance of lung. Left lung normal.

Pathological report (Drs. Brem and Zeiler): At the apex of the right ventricle is a rounded prominence about 4 centimeters in diameter. In the interior of the ventricle the apical portion is narrowed by a mass lying in the apex and pushing upward and inward the surface of the interventricular septum. Section of this mass shows an oval cyst 5 by 4 centimeters; attached to its wall is a wrinkled, folded membrane which is more or less translucent. The cardiac tissue covering the cyst is little more than the endocardium. The left ventricle is of normal size and not invaded by the cyst.

Microscopic examination. Section from the wall of the cyst shows an eosin-staining, lanceolated membrane without nuclei and outside this a fibrous, connective-tissue capsule; about this is a zone of inflammatory infiltration containing a few round cells and great numbers of eosinophilic leucocytes. Diagnosis: echinococcus cyst of heart.

Extract from Dr. Wagner's letter: "I believe the process started in the lungs and infected the heart by direct extension."

I believe, on the contrary, that the case was one of primary echinococcus cyst of the heart with secondary metastatic infection of the right lung. In the first place the relative size of the cysts points in this direction. I am aware that the age of an hydatid cyst of the lung cannot with certainty be estimated by its size (Dévé estimates it as the size of a nut in 2 years). Nevertheless it must be remembered that a secondary cyst of the lung may be actually larger than the original heart cyst, for the former grow relatively more quickly owing to their non-resistant environment. Dévé mentions a case where the primary heart cyst was the size of a pigeon's egg and the secondary lung cyst as large as a hen's egg.

In this case, as a matter of fact, the heart cyst was larger than any of the four lung cysts. Though the heart cyst here contained no daughter cysts or scolices, yet its nature was proved by the typical laminated structure of the cyst wall, and the cyst itself was obsolescent.

The situation of the lung cysts, four in number, all together and contiguous to the heart (so much so that Dr. Wagner suggested "direct extension" from one to the other) immediately suggests their development as a colony from four scolices in the same brood capsule.

Multiplicity of cysts of the lung (more than two or three) suggests in itself their secondary origin; so also does their relatively cortical position, though it has been noted that metastatic cysts of the lungs may be occasionally central. One may mention here incidentally that whereas secondary metastatic echinococcosis of the lungs (which has never yet been diagnosed during life) is fatal, primary parabronchial hydatid cysts of the lung show spontaneous cure by vomica in 80 per cent of cases.

The picture is not as typical as that in Grulee's case, for there the metastatic lung cysts were bilateral (as they are as a matter of fact in 83 per cent of cases, though in three reported cases they were definitely stated to be unilateral), and the heart cyst contained daughter cysts—an evidence of age or previous rupture. Nevertheless my explanation is practically certain to be the correct one, as the converse—a secondary heart cyst from a primary lung cyst—is impossible; the pulmonary filter is permeable to the hexacanth embryo of 36 microns diameter, but not so to the scolex which is five or six times larger. The obvious difference in their age and the fact that no hydatid cyst obtained in the liver, precludes the idea of multiple contemporaneous primary cysts from massive infestation. In some cases the parent cyst in cases of metastatic echinococcosis of the lung has been located in the liver and the iliac bones, but in 75 per cent of such cases the right heart is found to be its seat. In echinococcosis hydatidosus, infection by direct extension does not obtain; the hexacanth

Fig. 1. Hydatid cyst in apex of right ventricle of heart. Illustrates the case reported in this article — that of Dr. A. F. Wagner of Los Angeles, California. Postmortem specimen from a Frenchwoman age 36 who died suddenly.

embryo travels via the blood stream: the cross-country-like-a-pack-of-hounds theory is obsolete. The lymphatic route is unproven.

The embryos can and do traverse both the hepatic and pulmonary filters: 75 per cent of them are arrested in the former and 10 per cent in the latter, leaving only 15 per cent to develop into primary cysts elsewhere in the body.

The usual course of events in such cases as these is as follows: a primary hydatid cyst of the heart results from an embryo which has surmounted both the hepatic and pulmonary fences. This cyst, because of its uneasy location, ruptures early. This primary rupture is *not* usually fatal, and, as a matter of fact, passes unnoticed. Secondary metastases of the lungs or brain, as the case may be (right or left heart), result from the flooding of the venous or arterial circulation with hydatid sand, i.e., brood capsules and scolices. No case of hydatid cyst of the heart has ever been diagnosed in a living subject, though Cerné once rightly suspected one. The X-ray will, sooner or later, wipe out this reproach. In this connection it may be well to note that whereas various cardiac murmurs have been noted in some of the cases reported, such lesions are usually "silent." Arnould particularly in his article on the syncopal form of pulmonary echinococcosis draws attention to this fact, thus, "No hæmoptysis, expectoration of pus or hydatids, cough or dyspnœa: *and no particular cardiac symptoms*. Syncopal attacks recur without apparent cause; these crises somewhat resemble epilepsy. Sudden death occurs and the autopsy reveals metastatic pulmonary hydatid cysts *plus a latent heart cyst*."

In the meantime, while the metastatic cysts are developing, a change occurs in the parent heart cyst, which now becomes multivesicular—a purely defense reaction. Sooner or later a secondary rupture occurs. The primary rupture passes unnoticed because the elements set free are microscopical. The secondary rupture is immediately fatal in the great majority of cases from gross, massive, brutal embolism (daughter cysts, membrane, etc.) of the pulmonary artery or brain. In the case of the pulmonary artery, the five known exceptions are the cases reported by Andral, Budd, Wanderlich, Letten and Chiari, in which death was deferred for several months. Such is the graphic picture—and we are indebted for it to F. Dévé.

That spontaneous cure of hydatids of the heart does occur occasionally we know from the cases cited by Coote, Rokitansky, Goodhart, Habershon, and Madelung.

In North America this is the third case of echinococcus cyst of the heart which has been reported. The first was Grulee's (Italian female, age 17) in 1905. The second was reported by Davis and Balboni under the title of "hydatid cyst of the brain" (case 26) in 1917. Lyon's statistics, which included the earlier ones of Osler and Sommer, and appeared in 1901, contained no case of echinococcus disease of the heart. Most of the cases reported throughout the world have been in young subjects, average

age 23, though Klehmet's and Grulee's were aged 27, Rose's aged 30, and the oft-quoted one of Bernheim, 67.

HISTORICAL

Hydatid cysts of the heart were reported in the 17th and 18th centuries by Thebesius, Rolfincke and Fanton, and at the beginning of the 19th century by Portal, Dupuytren, Meckel, Price, and Morgagni. All these cases are dubious as the word "hydatid" had then a very vague significance.

The first paper of any importance was that by Griesinger, who collected 15 cases of "hydatid disease of the heart" (some of these were cases of cysticercus) in 1846.

In 1858 Budd reported five cases. One of them was a case of a female aged 23: here during life a cardiac murmur obtained and postmortem a cyst the size of an orange full of daughter cysts was found projecting into the right ventricle; the right auricle and right ventricle were full of blood clot; a small vesicle was found free under the tricuspid valve and several in the pulmonary artery (cit. Davaine and Thomas).

In 1860 Wilks published a case (patient of Henderson of Deptford, a medico-legal postmortem on a female age 19), in which an hydatid cyst the size of a billiard ball was found free in the left ventricle, in the wall of which the parent cyst had developed· an hydatid cyst of the liver also obtained. (Cit. Davaine, Thomas, Bobowicz and Vegas and Cranwell.)

In 1864 Cobbold in a review of 136 English cases found the eight following cases of hydatid cyst of the heart:

T. Trotter — 1796 (regarded as doubtful by Davaine).

D. Price — 1822, male age 10 (obs. xi of Davaine).

R. Smith — 1838, cyst filled right ventricle so as to block the pulmonary artery (Smith and Broderibb—Davaine obs. viii).

H. Coote (of Barts) 2 cases: one a dissecting room subject in which an hydatid cyst of the wall of the left ventricle had undergone spontaneous cure (compare cases of Rokitansky, Goodhart, Habershon, and Madelung).

Cases of Budd and Wilks, above referred to.

Vines—1845, autopsy specimen from a man who died suddenly. An hydatid cyst of the liver had ruptured into the inferior vena cava with resulting hydatid emboli of the right heart and pulmonary artery.

In 1868, Oesterlen reported a case of hydatid cyst of the left auricle which had perforated the cavity, releasing many daughter cysts with resulting hydatid embolism of the common iliac and deep femoral arteries.

In 1872 L. de Welling of Paris published his thesis based on 30 collected cases. His list was not complete, Davaine's and Charcot's, 1862, case among others being omitted; also many of his cases are very dubious, i.e., Trotter, Dupuytren, Rutty, Morgagni (cysticercus), Otto, Andral (cysticercus), William.

In 1877 Neisser's paper appeared containing reports of 29 cases.

In the same year Davaine published his *Traité des Entozoaires* in which hydatid disease of the heart and vessels is fully dealt with. He gives many case reports, including that of Herard whose patient expectorated hooklets and in whose interventricular septum were found, postmortem, 12 hydatid cysts.

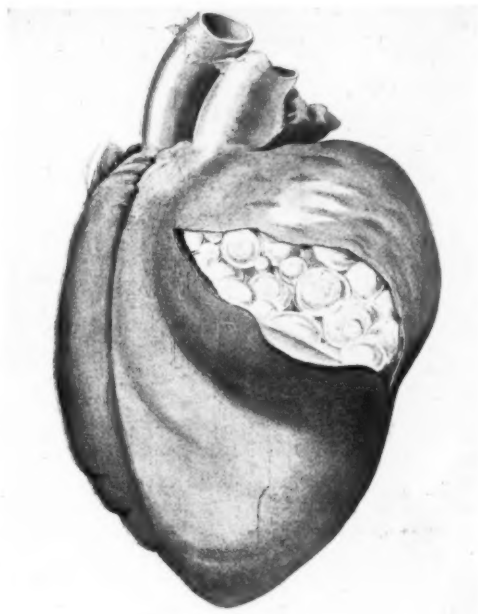

Fig. 2. Hydatid cyst in wall of left auricle of heart showing daughter cysts *in situ*. Taken from *Hydatid Disease* by James Graham, and reproduced here by permission of the publishers, Young J. Pentland.

Another of his cases quoted (obs. 19 bis) is that of Barclay whose patient was a sailor age 26 — incidentally hydatid disease is very rare in sailors (Budd) — in whom one of several hydatid cysts of the heart had ruptured into the right ventricle. Both lungs were full of cysts. One of these cysts had perforated on the left side and had caused pleurisy.

Boecker's case (Davaine obs. 19 ter) may also be mentioned—a boy age 15 whose heart was larger than a child's head and bosselated. Postmortem, multiple hydatid cysts of his heart were found: two the size of apples, of the left auricle, with a smaller one between them: others attached to the right auricle and pulmonary artery: many daughter cysts: hydatid embolism of left renal artery. This case is cited by Welling.

Mosler's article appeared in 1883 with 29 observations.

In 1884 Thomas of Australia added 18 new cases to Welling's list of 30, bringing up the total to 48. In 29 of the 33 cases in which the age was noted the patient was under 40, and in 15 cases under 20. In 31 cases the heart only was affected, and in 17 cases multiple hydatid cysts obtained elsewhere. He mentions Otto's (dubious) case in which 70 to 80 hydatids were attached by pedicles to the free edge of the Eustachian valve — also Kelly's case in which an hydatid cyst of the left auricle ruptured and released a daughter cyst the size of a walnut which blocked the auriculo-ventricular orifice with fatal result.

In 1887 appeared Bobowicz's thesis based on 6 cases not mentioned by Welling. In his first quoted case (that of Corneau) two hydatid cysts the size of a pigeon's egg obtained in the left ventricle of the heart.

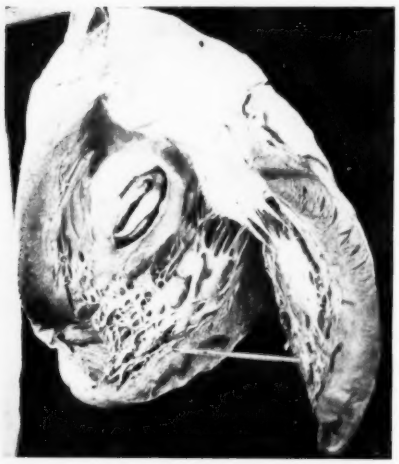

Fig. 3. Hydatid cyst in interventricular septum. Taken from "Hydatid Disease in Australia" by Professor A. Watson, Surgery, Gynecology and Obstetrics, 1907, iv, 759.

In 1891 Graham mentions the following cases:

1. Hydatid cyst of left auricle in a man who dropped dead while at work. Numerous daughter cysts obtained and the cyst had ruptured into the pericardium. A photograph of this specimen is here reproduced by permission of the publishers.

2. Boy with hydatid cyst of right ventricle blocking the pulmonary artery: sudden death. Reported by Bird of Australia, 1873.

3. Boy aged 18 with hydatid cyst of the right ventricle. Reported by Peacock and Hicks from St. Thomas' Hospital, London, 1864. Daughter cysts and multiple liver and abdominal cysts also obtained. This case is cited by Welling, Davaine, Thomas, and E. Dévé and M. Bopp.

4. Hydatid cyst in apex right ventricle size of hen's egg and full of daughter cysts. Reported by Stirling and Allen of Australia, 1879. Cited by Thomas.

5. Museum specimen from Sydney, Australia, of hydatid cyst of the interventricular septum, occupying ¾ of the original space of the left ventricle.

6. Boy — hydatid cyst of right ventricle, pulmonary artery blocked, sudden death. Smith and Broderibb, Lancet, 1837–8, p. 628. Cited by Davaine and Thomas.

It will be noted that in cases 1, 3, and 4 daughter cysts obtained, i.e., that a previous rupture had probably taken place.

Cases 2 and 3 were in young lads as is usual, but case 1 was definitely stated to have been in an adult man.

Coming now to the present century. Hydatid cysts of the heart are rare, obtaining as they do in less than 2 per cent of all cases of echinococcosis: contrast liver 75 per cent and lung 10 per cent.

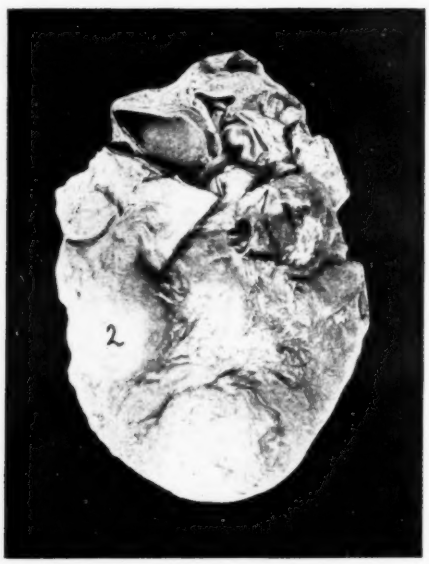

Fig. 4. Two hydatid cysts of the heart, one in the left auricle and the other in the right auricle. From *Los Quistes Hidatidicos en la Republica Argentina* by Vegas and Cranwell, published by Coni Brothers, 1901.

Vegas and Cranwell report one among their 970 cases, in 1901. They mention that 48 cases obtained in literature up to that time (i.e., the 48 cases tabulated by Thomas). Their own case was that of a man with multiple hydatid cysts in various organs. Postmortem were found an hydatid cyst of the left auricle the size of a hen's egg and a cyst of the right auricle, rather larger.

In 1903 Calvert reported an hydatid cyst of the heart (obs. 11 of Dévé and Bopp). The case was that of a girl age 22 who entered hospital June 6, 1903, and died July 23 of the same year. There was a history of hæmatemesis and she had been treated for gastric ulcer. Cough and dyspnœa had obtained for 6 months. On June 23 she expectorated hydatids, a systolic murmur obtained, also râles in both lungs. On June 26 she had an attack of hæmoptysis and the temperature rose to 101.2° F. On July 14 an erythematous eruption appeared on the chest and pleurisy was found to obtain (this according to Finsen means opening of the cyst into the pleura). A marked to and fro murmur was also noted. July 22 operation by Turner. Resection of the ninth right rib; tumefaction felt in center of lung: latter sutured to the surface and wound packed. July 23 died from syncope. Postmortem: heart — hydatid cyst slightly smaller than a golf ball in apex of right ventricle, two-thirds projecting into ventricle, ruptured and daughter cyst escaping: another daughter cyst free under tricuspid valve. Lungs — both contained innumerable hydatid cysts from the size of a pea to a big nut. Many daughter cysts free in bronchi. Hydatid cyst of heart primary with secondary echinococcosis of lungs. No hydatid cysts elsewhere. This was doubtless a case of the "rupture iterative" of Dévé.

Quill in 1904 reported a case of hydatid cysts in heart and lung simulating pulmonary tuberculosis (obs. xii of

Fig. 5. Hydatid cyst of the right auricle of the heart. From Dévé and Bopp, "L'Echinococcose Pulmonaire Metastatique" Thèse de Paris, 1916. Specimen sent to the Pathological Institute of Tuebingen in 1875 by Dr. W. Palm of Ulm.

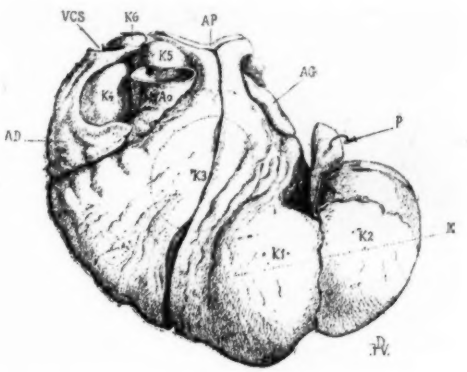

Fig. 6. Multiple hydatid cysts of the heart. *1* and *2* cysts of left ventricle; *3* suppurating intrapericardial cyst projecting opposite the infundibulum of the pulmonary artery; *4* and *5* cysts developed at the level of the sinus of Theile; *6* cyst of right auricle. Specimen from a young French soldier who died suddenly, sent by Dr. Jirow to F. Dévé for examination. From F. Dévé's *Kyste hydatique du coeur compliqué d'échinococcose secondaire du péricarde. Mort rapide par rupture d'un des kystes péricardiques par l'oreillette gauche.* Masson et Cie, 1920.

Dévé and Bopp). The case was that of a Scotch soldier age 23 with symptoms of tuberculosis — hæmoptysis, night sweats, evening temperature, wasting, etc., but not the physical signs of phthisis. Suddenly intense dyspnœa occurred followed by collapse, and he died in a few hours. Postmortem: heart — large antemortem clots in both ventricles. In right ventricle a large pedunculated hydatid cyst, with daughter cysts free in ventricles. The fatal dyspnœic attack caused by blocking of the pulmonary artery by daughter cysts. Again the "rupture iterative" of Dévé. Lungs: right — hydatid cyst size of small orange in center, and several other scattered ones. Left — a big superficial cyst, the size of an orange, at its summit, with three smaller scattered ones. No hydatids elsewhere.

Grulee in 1905 reported a case of echinococcosis of the heart (obs. xiii of Dévé and Bopp). His patient was an Italian woman age 27 who had been 1 year in America. She had symptoms of pulmonary tuberculosis, was pregnant, and had loud systolic pulmonary and apical murmurs. On April 5 she coughed up an hydatid cyst. On April 10 she died suddenly: postmortem cæsarian section. Postmortem: heart — hydatid cyst size of a pigeon's egg in posterior wall of right auricle which had ruptured into its cavity. The clot contained several daughter cysts. The walls of the heart cyst were drier and harder than those of the lung cyst. Lungs — both full of hydatid cysts size of pea to hen's egg. Right lung only tubercular. No hydatid cysts found elsewhere. Again, "rupture iterative" of Dévé.

Watson, of Australia, reported and figured a case in 1906.

Cristopherson, in the Sudan, reported a case of hydatid cyst of the left ventricle in a man, age 40, in 1909. Sudden death occurred a few days after an operation for elephantiasis of the scrotum, and the cyst was discovered postmortem. A primary rupture had passed unnoticed, for the cyst was full of daughter cysts. Incidentally this was probably one of those cases so aptly described by Dévé, in which the heart cyst had first ruptured outwardly into the pericardium (only one such rupture is possible because of the adhesions produced) and subsequently intracardially.

Baecchi, in 1909, reported a case of hydatid cyst of the heart and compared it with 58 others which he had collected from literature.

In 1911 Lemanski, Durand, and Roques reported a case of hydatid cyst of the heart (obs. xiv Dévé and Bopp). Girl age 17 with symptoms of pulmonary tuberculosis. No heart murmurs. Dyspnœa and severe neuralgia in sixth interspace. Died suddenly. Postmortem: heart — right auricle showed a large papillomatous vegetation on its posterior wall, and a cavity contained an hydatid cyst the size of a pigeon's egg. Many daughter cysts. Lungs — right and left contained about 12 cysts each. No hydatid cysts elsewhere. Primary hydatid cyst of the heart with secondary metastatic pulmonary cysts.

In 1915 Foresti and Bonaba, of Uruguay, reported "a case of multiple visceral hydatid cysts (heart, brain, kidneys): rupture of an hydatid cyst into the left auricle" in a girl of 17. The left ventricle was full of daughter cysts and a cyst opened into the left auricle. The right auricle was deformed by a cyst the size of a nut, full of daughter cysts. The mother cyst here was in the left heart instead of the right as usual.

In 1916, the total number of reported cases had risen to 105 according to Dévé and Bopp who reported a hitherto unpublished case from the Pathological Institute of Tuebingen (obs. xv), sent to the institution by Dr. W. Palm, of Ulm, in 1875. Postmortem specimen of heart — right auricle contained an hydatid cyst the size of a prune with several daughter cysts. Many hydatid cysts, from the size of a cherry down, in the adjacent piece of attached lung. Primary hydatid cyst of the heart with secondary pulmonary metastases. In 48 of these 105 cases intracardial rupture had occurred 28 times into the right heart.

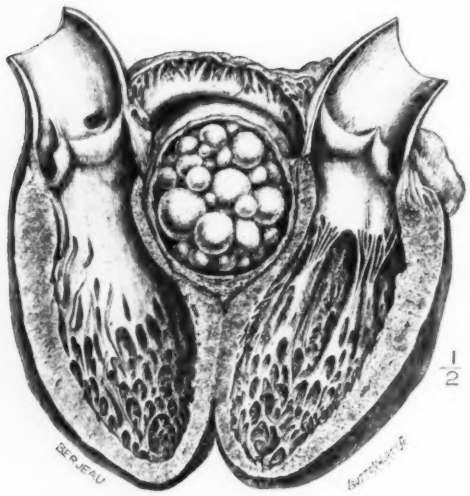

Fig. 7. Hydatid cyst in the loose tissue of the auriculo-ventricular septum of the heart. This plate illustrates the point, especially labored by Bland-Sutton, that the selective habitat of the parasite is the loose subserous tissue. From *Tumors, Innocent and Malignant*, by Sir John Bland-Sutton, 1922. Reproduced here by permission of the publishers, Messrs. Cassell & Co. Ltd.

In these latter the results were as follows: 5 times sudden death from anaphylaxis; in 11 cases death occurred in a few months from vesicular emboli of pulmonary artery; 12 times subsequent pulmonary metastases resulted.

In 1920, Arrizabalaga, of Uruguay, published a paper on venous hydatid metastases, pointing out that the original cyst is usually in the right heart, and the lung metastases usually multiple and small, seldom as large as an orange.

In 1921 Martin and Crespigny, of Australia, reported a case of hydatid cyst of the heart. Postmortem — hydatid cyst 5 centimeters in diameter of right auricle with many daughter cysts. Again an example of "rupture iterative" of Dévé.

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ABSCESS OF THE LUNG

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IN spite of the fact that within recent years complete and authoritative articles on abscess of the lung have been published, I make no apology for again bringing this serious disease to the notice of the medical profession.

There are few conditions, which, arising often from such trivial and preventable causes as does abscess of the lung, so quickly and completely incapacitate a person, rendering him a burden to himself, his friends, and society. The progressive weakness, the distressing cough, the long convalescence, and above all, the foul smelling and tasting sputum, break the morale of the stoutest patient, and present one of the most difficult conditions to relieve.

Because localized gangrene and abscess are so closely associated, it is usually impossible to determine whether or not one has supervened on the other or preceded the other. For the purpose of discussion, we include under abscess of the lung all types and degrees of abscess except those due to tuberculosis and bronchiectasis and all degrees of gangrene of the lung except a massive gangrene involving an entire lobe or lung. During the war, I saw many of the latter due to anaerobic infection on a traumatic lesion but, apart from these, I have seen only five cases of massive gangrene in civil practice.

HISTORY

Hippocrates pointed out that lung abscess sometimes bursted into a bronchus and cured itself spontaneously; and that occasionally it ruptured into the pleural cavity and had to be drained. Willis, in 1664, and Purmann, in 1692, suggested incision for drainage, and Baglivi, in 1696, opened a lung abscess resulting from a saber thrust. Great impetus was given to the study and treatment of the condition in the eighteenth century. DuBarry, in 1725, reported three cases, one of the patients died following drainage, and two recovered. Campardon, in 1759, described a cure following drainage. Sharpe, in 1769, suggested early intercostal puncture. Pouteau and David, in 1783, advised radical exploration and opening of abscesses. Pouteau, in 1793, reported operative cures, and in the same year Gumprecht published an exhaustive treatise on the condition. Faye, in 1797, reported a cure following operation. Because

TABLE I.—ABSCESS OF THE LUNG

	Cases
Males	41
Females	13
Age Incidence	
From 1 to 10 years	3
From 11 to 20 years	3
From 21 to 30 years	14
From 31 to 40 years	18
From 41 to 50 years	7
From 51 to 60 years	5
From 61 to 70 years	4
Leucocytes	
From 5,600 to 47,000	
Average 16,000	
Below 10,000	4
With leukopænia, 5,600	1
Average hæmoglobin	67 per cent
Cause	
Tonsillectomy (all general anæsthesia but one)	16
Extraction of teeth	3
Influenza	10
Pneumonia	2
Bronchopneumonia	1
Operation (harelip and cleft palate)	1
Operation (drainage of frontal sinus)	1
Inhalation (peanut, tack, and tooth)	3
Trauma	2
Hydatid cyst	1
Actinomycosis	1
Appendectomy	1
Polya operation	1
Focal infection (senile gangrene 1, vaccination 1, discharging sinus from scarlet fever 1)	3
Uncertain origin	7

TABLE II.—SYMPTOMS, COMPLICATIONS, SPUTUM, WEIGHT LOSS, WEIGHT GAINED

Symptoms	
Average duration (before coming to the Clinic)	18 weeks
Productive cough (foul and blood-stained sputum)	
Chills, fever, sweats	
Loss of appetite	
Loss of weight, progressive weakness	
Pain in chest	
Dyspnœa	
Clubbing of fingers	
Watch crystal nails	
Leucocytosis	
Low hæmoglobin percentage	
Recurrent type	
Complications	Cases
Empyema (one opposite chest)	4
Encapsulated empyema (same side)	2
Bronchiectasis (same or opposite side)	6
Senile gangrenous foot requiring operation	1
Subphrenic abscess (same side)	1
Hydatid cyst of the liver	1
Actinomycosis	1
Sputum, Scale 1 to 4	
1, 1 to 5 ounces each day	15
2, 6 to 10 ounces each day	18
3, 11 to 20 ounces each day	16
4	3
Amount indefinite	2
Foul (probably more)	25
Blood-stained at times	20
Elastic tissue (in one case only once in six examinations)	2
No tuberculosis bacilli	
Weight Loss	
From 5 to 53 pounds; average 37 pounds; more than 30 pounds	12
Weight Gained after Treatment	
From 11 to 80 pounds; often above normal; average pounds	32
Albumin in urine (probably more)	16
Clubbing of fingers (probably more)	14
Watch crystal nails (probably more)	11

of the indifferent results following surgery, and especially because of the influence of Trousseau, for the next one hundred years there was a return to more palliative methods of treatment.

Von Herff, Krimer, and Stokes, in the early part of the last century opened abscess cavities with a trocar. Bell, in 1805, reported one cured patient and several failures. Richeraud, in 1812, and Jaymes, in 1813, reported cures. Callisen, in 1815, advised digital exploration of the lung, accurately to outline the abscess and establish free drainage. Zang, in 1818, operated on eight patients. Breschet, in 1831, McLeod, in 1836, Claessens, in 1837, and Hastings, Herff and Collins, in 1844, reported cases. Nasse, between 1824 and 1844, advised surgery and operated on several patients successfully. Borchert pointed out that before undertaking drainage the exact site and limit of the lesion should be determined, and that no other foci should exist in the same or other lung. According to Garré, during the one hundred years, up to 1893, only twenty-two authentic cases are reported in the literature.

Green, in 1860, attempted to catheterize abscesses, and various injections directly into the bronchial tube were employed, but with unsatisfactory results. Maragliano, however, reported the cure of an abscess of 30 years' standing with injections of silver nitrate.

Koenig, in 1864, wrote at length on the subject, and a little later Jaszenko did some interesting experiments on penetrating intrathoracic and pulmonary wounds. In 1872,

TABLE III.—LOCALIZATION, TREATMENT

Localization in Lung	Cases
Right upper lobe	10
Right lower lobe	14
Middle lobe	2
Left upper lobe	5
Left lower lobe	8
Hilus (2 left, 1 right)	3
Not clearly defined	12
Treatment	
Medical	27
Dead	3
Not greatly benefited	5
Fair health	3
In good condition	16
Surgical	27
Dead	11
Good health	13
Fair health (discharging sinus)	3
Total number treated 54; deaths 14 (25.9 per cent)	
Duration of treatment in Clinic	44 days
Obliged to quit occupation on an average	13.75 months
Average time on treatment at Clinic or until returning to work	4.5 months
Patients obliged to change occupation entirely	7
Patients obliged to change climate entirely	6

TABLE IV.—DEATHS

On the day of operation (1, multiple abscess-empyema, 1, encapsulated empyema)	3
First day postoperatively	2
Second day postoperatively	3
In 3 months, inanition	1
In 5 months, suddenly brain abscess	1
Operated on twice elsewhere, entire lung gangrenous at operation, died the eleventh day	1
Without operation (1, multiple abscess, 1, multiple abscess and extensive cellulitis of the neck, 1, suddenly at home, apparently without relation to abscess)	3

Waring-Curran reported a spontaneous cure after the abscess had ruptured through the diaphragm, followed along the round ligament, and burst through the skin at the umbilicus.

Mosler and Hueter, in 1873, were the first deliberately to open a bronchiectatic cavity in the right upper lobe. They went through the third intercostal space, opened the cavity, introduced a tube through which pus was carried off, and irrigated the cavity with carbolic acid. Truc, in 1885, wrote a classical treatise on the subject, and Schmidt and Block the same year wrote on the surgical treatment.

Gluck, Schmidt, Block and Biondi, were the first to show that partial resection of the lungs was possible in animals. The work of Fenger, Bull, Reclus, Quincke, Tuffier, Karewski, and Garré followed.

Fenger, in 1881, reported 5 collected cases and 1 of his own; all the patients died following operation except his own. Bull, in 1882, reported 19 cases, of which 14 were probably true abscess. In 1884, he performed outstanding work for that period. Runeberg, in 1887, collected 11 cases, in which 2 patients had recovered following operation; in 3 cases the diagnosis was doubtful. Martius, in 1891, collected 22 cases in which abscess was found at necropsy only. Humber, in 1893, reported a successful operation for lung abscess on a child 13½ months old.

Artificial pneumothorax was employed for the first time in 1894. Forlanini employed it in the treatment of a tuberculous cavity. In 1897, Tuffier, in his classical monograph on thoracic surgery, collected 216 thoracic cases in which operation had been performed. In 36 there was definite cavitation, in 49 abscesses, and in 11 abscesses due to foreign bodies imbedded in the lung.

Murphy, in an address on thoracic surgery in 1898, was almost 20 years beyond his time. He advocated the treatment of lung abscess that should, in my opinion, be adopted today. Eisendrath, in 1901, collected 25 cases of abscess of the lung following pneumonia, 9 of which were in children under 12 years. McRae, in 1902, thoroughly reviewed the literature on the subject and reported 75 collected cases of lung abscess following pneumonia found at necropsy. In 1903, Garré collected 278 cases. During the past 20 years important contributions to the subject have been made by Lenhartz, Koerte, Kuelbs, Andrews, Lord, MacKenzie, Scudder, Tewksbury, Picot, Whittemore, Perthes, Robinson, Richardson, Meyer, Beck, Lillienthal, Manges, Tilton, Lloyd, Wessler, Norris and Landis, Hedblom, Hartwell, Lemon, Lynah, and others.

From April, 1920, to November, 1921, 54 patients were treated for abscess of the lung at the Mayo Clinic (Tables I, II, III, IV, and V).

ETIOLOGY

Predisposing causes are: diabetes, alcoholism, fatigue, exposure, starvation, wasting diseases such as typhoid and typhus, and

TABLE V.—ABSCESSES OF THE LUNG FOUND ONLY AT NECROPSY

Case	Sex Age	Operations	Leucocyte count probably after abscess had developed	Cause	Duration of illness, days	Location of abscess	Remarks, necropsy findings, abscesses
A366956	F 39	Splenectomy	21,900	Direct extension from subdiaphragmatic abscess	45	Left lower lobe	Right hydrothorax; left intraperitoneal subdiaphragmatic abscess; thrombosis of portal vein; ascites
A360015	M 66	Cholecystectomy; choledochostomy; appendectomy		Bilateral lobar pneumonia	10	Left lower lobe; multiple	Bilateral lobar pneumonia; death attributed to the diffuse pneumonia
A377385	M 68	Resection of bladder for cancer; 5 days later nephrectomy for pyonephrosis		Pyæmia-embolic	13	Multiple; bilateral	Pyæmia; uræmia given as the clinical cause of death
A288301	M 42			Influenza	25	Multiple; bilateral; both lower lobes	Bilateral empyema; cerebrospinal syphilis
A300039	M 62		12,100	Septicæmia from an infected finger	28	Multiple; bilateral	Multiple abscesses of lung, spleen and lymph nodes of right axilla and right lobes; staphylococcus albus found in the blood
A334735	M 61	Partial gastrectomy and partial duodenectomy			8	Multiple in right lung	Peritonitis; chronic diffuse nephritis; abscesses were probably embolic
A331580	M 78	Cholecystectomy and choledochostomy			16	Left lower lobe; multiple	Multiple lung abscesses
A332449	M 52	Posterior gastro-enterostomy for cancer of pylorus		Bronchopneumonia	9	Right upper lobe	Bilateral coalescing bronchopneumonia
A327262	M 70	Suprapubic prostatectomy		Bronchopneumonia, repeated multiple pulmonary emboli 8 days after operation	14	Multiple; both lungs	Acute and chronic cystitis with infection and necrosis of prostatectomy wound; thrombosis of prostatic plexus; propagating thrombus in the left, common iliac veins; multiple repeated pulmonary emboli with infarction; bronchopneumonia and multiple abscesses of both lungs
A304596	F 28		54,000	Influenzal bronchopneumonia	23	Right upper lobe	Bilateral empyema; bilateral purulent bronchitis
A304909	F 54		13,800	Bronchopneumonia both sides	14	Multiple; bilateral	Right empyema; coalescing bronchopneumonia
A371987	M 59	Posterior gastro-enterostomy. gastric ulcer	19,800	Bronchopneumonia	22	Right side	Gangrenous bronchopneumonia with a central abscess (right lung)

such malignant infections as variola. More direct causes are: operations around the nose and throat, lobar pneumonia, bronchopneumonia, influenza, bronchitis, emboli from distant foci, inhalation of foreign bodies, vomitus, or irritating gases, emersion, direct extension from adjacent collections of pus, as in empyema, subphrenic abscess, liver abscess, appendiceal abscess, and mediastinal abscess, breaking down of mediastinal or hilus glands, penetrating wounds, direct trauma of the chest wall, necrosis, syphilitic and carcinomatous lesions, ecchinococcus and dermoid cysts, and infections with actinomyces bovis, amœbic lung fluke, bacillus mallei and fungi of the genus oidium and aspergillus.

Opinions have always differed regarding the relative incidence and etiology of the disease. I have been impressed by the high percentage of patients in whom the condition follows operations around the nose and throat, and particularly tonsillectomy. In these days when tonsillectomy is so lightly advised and frequently employed, it should be thoroughly emphasized that lung abscess is not a rare sequela, nor one to be lightly entertained.

Not long since, I pointed out to a friend of mine, whose daughter was about to have a tonsillectomy under general anæsthesia, the danger of abscess following operation under such an anæsthetic, and urged the use of local anæsthesia. Ether was employed, the girl developed a lung abscess, and now (1 year later) she is slowly convalescing. Undoubtedly abscess occurs much oftener after tonsillectomy in which general anæsthesia is employed. In 25,000 tonsillectomies at the Mayo Clinic, one case only has occurred and that in association with general septicæmia. Richardson, in 1912, was the first to point out the occurrence of lung abscess following tonsillectomy under general anæsthesia. Bassin, in 1913, collected 16 cases following tonsillectomy. Manges reported 9 cases seen at Mt. Sinai Hospital in 1 year, and quotes Wessler that 28 per cent of the cases of pulmonary operations seen in the roentgen-ray department of Mt. Sinai Hospital were due to tonsillectomy. Pottenger, in 1919, reported having seen in one and one-half years, 20 cases following tonsillectomy. Of 32 lung abscesses reported by Whittemore, in 1921, 17 followed tonsillectomy.

Richardson believes that abscess is the result of an embolic process. Coakley, in discussing Richardson's article, says that abscess is due to the aspiration of infected blood or pieces of tonsillar tissue, "The thick, cheesy or thin milky, bacteria-laden secretion within the tonsils is expressed out either when the tonsils are seized by forceps, as in the dissection method, or as the tonsils are pushed through the fenestra of the tonsillotomy, as by the Sluder method." This seems logical. Emboli from the plexus of veins in the tonsillar bed undoubtedly cause a small percentage of such cases; but the majority of them follow aspiration. Of 208 reported abscesses of the lung following tonsillectomy, 7 only were in patients operated on under local anæsthesia. The following facts favor the theory that it is usually by aspiration that infective material is carried to the lung:

1. An extremely small percentage of abscesses of the lung have followed tonsillectomies and other operations on the nose and throat when local anæsthesia has been employed.

2. A higher percentage of abscess occurs in the insane, alcoholics, and drug addicts, than in a corresponding number of normal persons. This is undoubtedly because swallowing is not always the well controlled act by these persons that it is in normal persons. Under general anæsthesia, the influence of alcohol or drugs, the pharyngeal reflex is slowed or absent, so that mucus, vomitus, particles of food, blood, and so forth, readily enter the trachea.

Reports and opinions vary with regard to the incidence of lung abscess following lobar pneumonia. Early writers considered abscess of the lung a frequent sequela of lobar pneumonia. Laennec says that such abscess follows pneumonia so commonly that in the year 1823 he met with 20 cases. On the other hand, Fraenkel, in observing 1200 patients with lobar pneumonia, found less than 2 per cent with evidence of abscess. McRae collected 75 cases following acute lobar pneumonia. Hamman says that Aufrecht found none in 1501 patients with lobar pneumonia. Aufrecht, in 253 fatal cases of pneumonia, found only three abscesses at postmortem. Hartwell states that of 770 patients with pneumococcus lobar pneumonia at the Rockefeller Hospital, only 2 developed abscess. He quotes MacCallum: "I am skeptical about those abscesses said to occur in the course of a pneumococcus lobar pneumonia." In all I have collected only 127 cases reported as due to lobar pneumonia. I agree with Whittemore, who says: "Although medical books give lobar pneumonia as the most common cause of lung abscess, in my experience it has seldom, if ever, been the cause." In our last series, two cases only were due to lobar pneumonia.

Bronchopneumonia is followed by abscess in a small percentage of patients. I have collected 32 such cases. However, I agree with Hamman that lung abscess is more common following bronchopneumonia than following lobar pneumonia. One hundred and fifteen other cases are reported in the literature as following pneumonia, but it is not clearly stated whether they were lobar or bronchopneumonia. There is no doubt that particular-

TABLE VI.—CAUSE OF ABSCESS OF THE LUNG IN REPORTED CASES

Author, date	Preceding pathological condition	Aspiration of	Emboli from
Fenger, 1881	Actinomycosis 1	Foreign body 5	
McRae, 1902	Croupous or lobar pneumonia 75		
Clarke and Marine, 1906		Foreign body 31	
Tilton, 1907	Pneumonia, type not given 15; influenza 1		Abscess of the liver 1; abscess of the appendix 1
Guisez, 1912		Foreign body 5	
Bassin, 1913		Foreign material during tonsillectomy 19	
Kuelbs, 1913	Croupous or lobar pneumonia 8; pneumonia, type not given 6; purulent bronchitis 10; empyema 3		
Norris and Landis, 1913	Croupous or lobar pneumonia 9; bronchopneumonia 2; pneumonia, type not given 2; septicæmia 1; croupous or lobar pneumonia 3; bronchopneumonia 8; pneumonia, type not given 8	Tooth 1; tack 1; traumatized tissue 1; portion of cancer of œsophagus 1	Typhoid fever 1; suppuration in abdomen 1; abscess of kidney 1; abscess of lip 1; abscess of pharynx 1; abscess of seminal vesicle 1; abscess of skin 1; suppurative otitis media 4; vegetative carditis 4; thrombosis of lateral sinus and internal jugular vein, mastoid disease 1
Scudder, 1914	Pneumonia, type not given 7; actinomycosis 1	Foreign material during tonsillectomy, several	
Rist, Ameuille and DePfeffel	Amœbic infection 1		
Lord, 1915		Portion of tooth 9; portion of cancer of jaw 1; portion of cancer of lip 1; portion of cancer of tongue 1; pus from abscess of tonsils 1; foreign material during tonsillectomy 12	
Lloyd, 1915		Foreign material during tonsillectomy 3	
Richardson, 1916		Foreign material during tonsillectomy 3	
Manges, 1916		Foreign material during tonsillectomy 9	
Forbes, 1917		Tooth 1	
Yankauer, 1917		Snail shell 1; foreign material during operation on nasal septum 1	
Lewis, 1918		Foreign material during tonsillectomy 4	
Wessler, 1919	Pneumonia, type not given 37; empyema 3; mild influenza 21; diabetes 1; syphilis 1	Foreign material during tonsillectomy 21; material during coma from drugs and alcohol 2; sea water 2; foreign material during operation on nose 1; portion of cancer of œsophagus 1; foreign material during operation 5; traumatized tissue 1	
Schwartz and Wessler	Pneumonia, type not given 7	Foreign material during tonsillectomy 6	
Hedblom, 1919	Croupous or lobar pneumonia 11; pneumonia, type not given 12; influenza 1; empyema 2	Portion of tooth 1; foreign material during tonsillectomy 5; foreign body 2; traumatized tissue 1	Cancer of stomach 51; gastric ulcer 2; duodenal ulcer 1; abscess of appendix 1; abscess of liver 1; subdiaphragmatic abscess 1
Bullowa, 1919		Sea water 4	
Piller, 1919		Foreign material during tonsillectomy 6 or 8	
Tewksbury		Foreign material during tonsillectomy 1	
Simpson and Noah, 1920		Foreign material during tonsillectomy 2	
Lemon, 1920	Pneumonia,type not given 31		
Rendleman, 1920		Foreign material during tonsillectomy 1	
McKinney	Pyæmia 15	Portion of tooth 1; foreign material during tonsillectomy 2	Suppurative otitis media 5; thrombosis of pulmonary vessels 4

TABLE VI.—CAUSE OF ABSCESS OF THE LUNG IN REPORTED CASES—CONTINUED.

Author, date	Preceding pathological condition	Aspiration of	Emboli from
Hartwell, 1920	Croupous or lobar pneumonia 18; bronchopneumonia 22; purulent bronchitis 3; septicæmia 11	Foreign material during tracheotomy 2	Endometritis 7; infective endocarditis 6; venous thrombosis 8
Fisher, 1921		Foreign material during tonsillectomy 76	
Porter, 1921		Foreign material during tonsillectomy 4	
Williams and Dodd, 1921		Foreign material during tonsillectomy 3	
Meis, 1921	Croupous or lobar pneumonia 7	Foreign material during tonsillectomy 1; kernel of corn 2	Abscess of appendix 1; septic endocarditis 1; suppurative tonsillitis 1
Lynah, 1921	Croupous or lobar pneumonia 2; influenza 3; lymphosarcoma 1	Foreign material during tonsillectomy 8; sea water 2; foreign body 9	Infected gall bladder 1; abscess following diphtheria 10
Whittemore, 1921	Actinomycosis 2	Foreign material during tonsillectomy 17; portion of tooth 3; foreign material during operation on nasal septum 1	
Lockwood, 1921	Croupous or lobar pneumonia 2; bronchopneumonia 1; actinomycosis 1; echinococcus cyst 1	Foreign material during tonsillectomy 16; portion of tooth 3; foreign material during operation on nose 1; foreign body 1; foreign material during operation for harelip and cleft palate 1; traumatized tissue 2	Senile gangrene 1; vaccination 1; scarlet fever 1; infected appendix 1; Polya operation 1

ly in lobar pneumonia, a certain percentage of patients develop small petechial abscesses which clear up without going on to extensive cavitation; these cases are neither diagnosed nor thought of as lung abscess proper.

During the severe epidemic of influenza, a small percentage of patients developed true lung abscesses. Practically in every patient who died, necropsy revealed small subpleural abscesses, but only a small percentage of those who survived, developed necrosis and cavitation to a degree that the lesion could be diagnosed as lung abscess. In 10 cases of our series, influenza was given as the cause. Of 100 patients with prolonged influenzal pneumonia, quoted by Hedblom, abscess occurred in 3.

Empyema with rupture through the visceral pleura and extension into the parenchyma of the lung with the development of a true lung abscess does occur, but is extremely rare. The process is usually reversed.

A fair percentage of all the lung abscesses reported have been the result of aspiration of foreign bodies, or of infected blood and mucus from operations around the nose and throat, or during the extraction of teeth, or of pathological products of suppurative lesions around the nose, buccal cavity, and throat, from diphtheria, cancer of the lip, tongue, jaw, or larynx, diverticulitis of the œsophagus with regurgitation and difficult swallowing, cancer of the œsophagus or mediastinum perforating the trachea, and during examination with the bronchoscope or œsophagoscope, and the passing of an œsophageal bougie or stomach tube. Sixty-eight cases are reported due to inhalation of foreign bodies. Weist collected over 1000 reported cases due to aspiration of foreign bodies into the bronchi; a kernel of corn was the chief offender. Eight cases are reported following aspiration of sea water; Bullowa saw four such patients in 1 year. Five cases are reported following trauma. I have seen 4 such cases aside from those following gunshot wounds.

A definite percentage are due to embolism. Emboli may be carried to the lung in pyæmia, from suppurative middle ear diseases, puerperal sepsis, ulcerative endocarditis, gangrene, venous thrombosis, distant abscesses, and so forth.

Hartwell reported 4 cases of pulmonary thrombosis following general operations. Hedblom reported 19 abscesses found at necropsy following operations. It is possible that a small percentage of these may have been due to pulmonary thrombosis. On the whole,

however, I believe abscess is a rare sequela of such a condition. I have never seen such a case (Table VI).

MORBID ANATOMY AND PATHOLOGY

Abscesses of the lung may be large or small, single or multiple, acute or chronic, simple acute or acute gangrenous, or simple chronic or chronic putrid. An abscess that persists longer than 2 months is considered chronic. The pathology of abscess of the lung is as varied as its etiological factors.

Abscess of the lung differs from abscess elsewhere. In the lung a variable area, even a whole lobe, may be the seat of some other disease, the abscess developing within the diseased portion, whereas the tissues surrounding abscesses in other organs are usually normal. Abscess may develop in previously healthy lungs, but more often occurs in tissue already inflamed or at least in tissue offering a lowered resistance to such a process. For example, while aspiration abscess develops in healthy lung tissue, it probably more easily gains a foothold in the lung of a patient already debilitated or in a lung that has recently been the seat of a pneumonic process.

Traube, in 1823, classified pulmonary gangrene according to its origin in the blood vessels from embolism or thrombosis, in the bronchi or in the parenchyma of the lung. Abscess of the lung starts from these three sites. Generally speaking, there is localized or diffuse hyperæmia of a portion of the lung followed by diminished circulation to the part, ingress of pyogenic organisms, and necrosis and pus formation. In a pneumonic pulmonary abscess, the process is one of more acute inflammatory reaction, with exudation of leucocytes at certain points or in a single area not confined to the alveoli, but affecting the interalveolar tissue with a central area of necrosis, liquefaction, and cavitation. In the embolic and aspiration types, there is obstruction of the blood supply or of a bronchus, with localized ulceration, pyogenic infection, and necrosis.

A distinction between gangrene and abscess may be uncertain even at necropsy. Macroscopically, pulmonary abscess presents circumscribed, greyish yellow, greenish grey, or reddish brown areas containing pus, caseous débris, and often small isolated portions of pulmonary tissue and calcareous particles, so-called lung sequestra. The simple acute abscesses have necrotic walls and show almost no line of demarcation from the healthy lung tissue. This necrotic area is surrounded by a densely infiltrated inflammatory zone, and by an outer zone of œdematous lung tissue. The acute gangrenous cavities are more irregular, with reddish black, or greenish brown sloughing necrotic areas; they are extremely foul smelling and ill defined. They tend to infiltrate in the surrounding lung tissue, which is firm and airless and often the seat of small bronchiectatic cavities. The chronic abscesses are irregularly sacculated with a necrotic interior, but are usually walled off by a fibrous connective-tissue lining, and are nearly always surrounded by a limited area of bronchiectasis. The cavity ruptures usually into a bronchus, but occasionally into the pleural cavity, and in a small percentage it remains encapsulated with no outlet. I believe it is particularly from the latter type of abscess that bacteria reach the blood stream through the pulmonary veins and produce general septicæmia and pyæmia.

Pleural adhesions are present in the majority of the chronic cases, and probably in the majority of acute cases in which the abscess is situated peripherally. A fibrinous or seropurulent pleuritis and thickening of the visceral pleura covers the abscess area in most instances.

The bronchial glands are usually enlarged and the bronchial mucous membranes thickened and reddened by irritation. Often the mediastinal glands are enlarged. The bronchioles opening into the abscess in chronic cases are hard, sclerosed, and the seat of calcareous deposit, as are the adjacent vessels.

The majority of perforating abscesses from empyema rupturing through the visceral pleura into the lung, or through the diaphragm into the lung, usually show necrosis of a peripheral portion of lung tissue, without true cavitation. Occasionally well encapsulated abscess occurs not connected with the

empyema. It is probable that, primarily, a subpleural abscess, ruptured into the pleural cavity, caused empyema, and then healed on the visceral surface but extended into the tissue of the lung and developed into a true abscess.

Of 43 patients that I operated on late for the removal of pieces of shrapnel or bullets imbedded in the lung, 30 had a localized collection of pus around the missile but completely walled off from the healthy parenchyma by a definite fibrous sac. In only one case was there a patent bronchus opening into the cavity through which the patient raised some sputum.

If an abscess of the lung has developed around a foreign body imbedded in a bronchus, the abscess will be fairly well localized but extremely foul. Such a degree of necrosis indicates that the abscess supervenes on localized gangrene; a localized bronchiectasis usually surrounds such an abscess and extends along the involved bronchus.

The contents of pulmonary abscesses vary with the cause: pus, isolated shreds of lung tissue, hæmosiderin, cholesterol, pieces of metal, teeth, peanuts, kernels of corn, food particles, jelloid bodies typical of echinococcus, pieces of hair and so forth from a dermoid, and calcareous deposits may be found. In one case I found a calcareous sequestrum irregular and jagged, measuring about 3 by 1.5 centimeters. Fraenkel reported a deposit about 4 by 6 centimeters, in a large cavity in the right upper lobe.

BACTERIOLOGY

The bacteriological findings in abscess of the lung vary widely. While pyogenic organisms cause most of the abscesses, saprophytes are sometimes the cause. Anaerobic organisms are found in a fair percentage of cases, but practically always associated with pyogenic types. Even in abscess following lobar pneumonia, the pneumococcus or pneumonia bacillus of Friedlaender is almost always associated with other pyogenic strains. The bacillus of influenza, staphylococcus pyogenes aureus or staphylococcus pyogenes albus are present in many abscesses, very often streptococcus viridans, occasionally streptococcus hæmolyticus, and sometimes bacillus coli.

Cohn reports a case due to Friedlaender's bacillus only. Koranyi obtained a pure culture of staphylococcus pyogenes aureus from the blood of one patient, but could not demonstrate pathogenic bacteria in the sputum. Hartwell, in 148 patients with lung abscess and gangrene, found staphylococcus pyogenes aureus in most cases. Hitzig made eight bacteriological examinations of the sputum of a patient with abscess in the right lower lobe, and found the typical bacillus of influenza in every instance, but no other organism. The sulphur bodies of actinomycetes, filamentous organisms, yeast fungi, and spirochætæ should be looked for. Buday has found the fusiform bacilli and spirilla in most of the so-called gangrenous abscesses.

THE LOCATION OF ABSCESSES

The majority of abscesses develop in the peripheral portion of the lungs. In 71 of my cases, 57 (79 per cent) were peripheral; a small percentage occur in the hilus, and the rest centrally in the lobe.

Norris and Landis assert that they occur nearly three times as often in the right lung as in the left, and Lemon says that they occur three times as often in the lower lobes as in the upper. In Lemon's series they occur only twice as often in the right lobes. In 292 cases collected by Lemon, 86 were in the upper lobe, 192 in the lower, and 14 in the middle (Walker, Wessler, Norris and Landis, Lemon). I found in 537 collected cases, 381 (71 per cent) on the right side, and 156 (29 per cent) on the left side; 157 occurred in upper lobes, and 266 in lower lobes. That is, the right side was involved two and one-half times as often as the left, the lower lobes one and two-thirds times as often as the upper, the right upper lobe three times as often as the left, and the right lower, one and one-third times as often as the left lower, the middle lobe three-fifths as often as the upper lobe and about three-eighths as often as the lower lobe. Multiple abscesses occur in approximately one-fourth of the cases, but are confined to the same portion of the lung in all but about one-thirtieth of the cases.

TABLE VII.—LOCATION OF ABSCESS

Location	Patients	Per cent
Right side	381 of 537	71.0
Left side	156 of 537	29.0
Upper lobes	157 of 447	35.0
Lower lobes	266 of 447	60.0
Middle lobe	24 of 447	5.0
Right upper lobe	40 of 193	21.0
Middle lobe	24 of 193	12.0
Lower lobe	67 of 193	35.0
Left upper lobe	13 of 193	7.0
Left lower lobe	49 of 193	25.0
Acute	95 of 221	43.0
Chronic	126 of 221	57.0
Peripheral	56 of 71	79.0

Abscesses due to pneumonia and influenza are practically always peripheral and usually involve the visceral pleura. They occur about twice as often in the right lower lobe as in the left. According to Tuffier, 80 per cent of pneumonic abscesses are in the lower lobes. They are often multiple but are usually confined to one lobe. In 160 patients with lung abscess following pneumonia, the abscess occurred in the upper lobe in 46, and in the lower lobe in 102; two and one-fourth times as often in the lower lobe as in the upper. The right lower lobe was affected one and seven-ninths times as often as the left lower. On the whole, the right side was involved three and two-fifths times as often as the left.

Aspiration abscesses including those following tonsillectomy occur about three times as often on the right side as on the left and about two and one-half times as often in the upper lobe as in the lower. Abscesses following the aspiration of foreign bodies, such as tacks, teeth, and so forth, occur more often in the right lower lobe. The majority of those due to trauma occur in the right lower lobe (Tables VII and VIII).

SYMPTOMS

Abscess of the lung is a disease of symptoms rather than physical signs. The symptoms vary with the cause of the disease, the general resistance of the patient, the duration of the affection, and the extent of pulmonary involvement. When the abscess is due to pneumonia, prolonged fevers, septic emboli, or the more acute infectious fevers, the evidence of the development in the lung may be masked by the general constitutional signs of the disease. However, when cough, dyspnœa, pain in the chest, and the raising of foul sputum are added to the disease or are prolonged after the period that the ordinary affection of the lung or respiratory tract usually persists, abscess should be suspected. When abscess develops in cases of lobar pneumonia, although the temperature may fall as usual, it gradually mounts again usually higher than during the course of the disease, and is characterized by morning remission and evening exacerbations. The area of consolidation fails to undergo resolution, dullness persists, and bronchial breathing and diminished breath sounds will be detected on auscultation. As the process of necrosis and liquefaction continues, the sputum becomes thicker and more putrid, there may be signs of cavitation, a tympany on percussion, whispering pectoriloquy, amphoric or cavernous breathing, and coarse crepitant râles. Occasionally the pneumonia runs its regular course and the patient appears to all intents and purposes to be recovering entirely except that a small localized area of dullness still persists. About the fifteenth or twentieth day, patients begin to run an irregular fever, develop vague joint pains, occasional headache, and pain in the chest. A cough develops, then dyspnœa and suddenly, in a severe coughing attack, pus gushes from the mouth. Often (I believe in about 50 per cent of such cases) bright blood, varying from the faintest trace to a pint appears. I cannot find a case reported of fatal initial hæmorrhage in pyogenic lung abscess. The patient may recover rapidly after this, or he may recover partially, only to have similar repeated attacks, or run the course of an ordinary lung abscess.

Lung abscesses following tonsillectomy usually produce foul expectoration by the tenth or fifteenth day. Wessler states that sputum in an aspiration abscess becomes putrid on the fourteenth day. The great majority of these patients, if carefully observed, will show signs of a localized bronchopneumonia before the third day. A small percentage does not produce sputum before the third week, and in some cases not until the fifth or sixth week; they present the

TABLE VIII.—LOCATION OF ABSCESSES DEFINITELY STATED

Author, year	Cases	Right upper lobe	Right middle lobe	Right lower lobe	Left upper lobe	Left lower lobe	Right side	Left side	Upper lobe	Lower lobe	Multiple
Waring-Curran, 1872	1						1				
Fenger and Hollister, 1881	5		2	2		1					
Westbrook, 1886	1	1									
Aufrecht, 1902	27						11	16			
Clarke and Marine, 1906	21						14	7			
Koerte, 1908	37	5	1	14	3	14					
Barrington, 1913	6	1		3		2					
Norris and Landis, 1913	30	7		11	1	7	4				
Walker, 1914	142						81	54			7 both sides
Scudder, 1914	16	8				8					
Manges, 1916	8	4	1		1		1	1			
Yankauer, 1917	1						1				
Tewksbury, 1918	10						7	3			
Hedblom, 1919	48	4	3	23	3	9					1 right upper and lower 1 right lower and middle. 4 others
Wessler, 1919	99		4						42	53	
Schwartz and Wessler, 1919	19								2	11	2 upper and lower lobes
Lemon, 1920	68		8						15	45	
Hartwell, 1920	50		3						25	22	
Whittemore, 1921	41								22	19	
Lockwood	42	10	2	14	5	8	1 hilus	2 hilus			
Total		40	24	67	13	49	150	94	104	150	15

same signs as the delayed pneumonia type and eventually rupture into a bronchus and run the same course as the group described following pneumonia. These abscesses are probably due to emboli from the tonsillar bed; necrosis and liquefaction occur and eventually the pus bursts through a bronchus and is spat up.

Regardless of the cause, loss of appetite, progressive loss of weight, emaciation, general weakness, pallor, productive cough, foul sputum, pain in the chest, variable dyspnœa, fluctuating temperature, and leucocytosis characterize the disease. In the closed type of abscess there is usually a peculiar putrid odor to the breath even though there is no sputum. Clubbing of the fingers occurs in most cases and watch crystal nails in a certain percentage. The peculiar clubbing of the fingers, characteristic of pulmonary hypertrophic osteopathy is interesting; Phemister and Butler have been particularly interested in it. The hæmoglobin is reduced in all chronic cases. In most cases the red count is low. Chills and sweating occur in most patients at some stage. Approximately 50 per cent of all patients have some blood in the sputum at some time during the course of the disease. Although Osler found elastic tissue in the sputum of every patient, and although Aufrecht says "The presence of abscess of the lungs can be positively assumed only when elastic fibers can be demonstrated in the sputum," a study of the literature and personal experience has led me not to expect it in more than one-third of the cases. In the

TABLE IX.—ULTIMATE RESULTS

Author, year	Cases	Mortality						Cured		Improved		With fistula	
		Medical treatment		Surgical treatment		Medical or surgical treatment							
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Fenger and Hollister, 1881	6			5	83.0			1	17.0				
Trzbicki, 1892	42* 24†			24 13	57.0 54.0			14§ 7§	33.0 29.0	1	4.0	1	4.0
Quincke, 1896	54					20		20					
Tuffier, 1897	23			6	26.0			17	74.0				
Murphy, 1898	71 96			16 37	28.0 39.0			49 59	61.0 61.0			5 3	7.0 3.0
Schultz, 1901	14 22			6 7	43.0 33.0			9	41.0	8 6	57.0 27.0	4	18.0
Eisendrath, 1901	25* 28† 14‡ 26¶			6 5 9	21.4 35.8 34.7			24 20 6 13	96.0 71.4 42.8 50.0	1 2 3 4	4.0 7.2 21.4 15.3		
McCrea, 1902	75			16	21.3			51	68.0	8	10.7		
Garré, 1902 1903	11 400			100	25.0	3	27.0	8	73.0				
Karewski, 1903	14					1	7.0						
Lenharz, 1905	23					12	51.0	11	48.0				
Kissling, 1906	120			49	40.8§§			71	70.1				
Tilton, 1907	20			10	50.0			10	50.0				
Perthes, 1908	54			20	37.0			20	37.0				
Koerte, 1908	37 28			8	28.5	12	31.0	25 20	68.0 71.0				
Picot, 1910	133 149 400	123	93.0	44 100	30.0 25.0								
Garre, 1912	182			34	18.6								
Bassin, 1913	19			4	21.0								
Krause, 1913	9					4	44.0	5	56.0				
Kuelbs, 1913	24 17	8	47.0	7	29.0			14 5	58.0 29.0	3 4	13.0 24.0		
Walker, 1914			54.0		25.0								
Scudder, 1914	27 16			5	31.0	9	33.0						
Jakobaeus, 1914	16	2a	12.0					12	75.0	2	12.0		
Baron, 1914	7c					7	100.0						
Whittemore, 1915	27					7	25.0						
Lord, 1915	31			5	16.0			5b	16.0				
Manges, 1916	6						22.0						
Bergman, 1916	5	1a	20.0					3	60.0	1	20.0		
Tewksbury, 1918	10	2a	20.0					6	60.0	2	20.0		
Goldberg and Biesenthal, 1919	16	2a	12.0					12	75.0	2	12.0		
Gordon, 1919	17	6	35.3	11	65.0			7	41.0				
Hedblom, 1919	54 17			18 4	33.3 23.5								

*Simple abscess. †Gangrenous abscess. ‡Chronic simple abscess. ¶Chronic putrid abscess. §Result unknown in remainder. §§ Several cases complicated with diabetes and tuberculosis; with these excluded death rate is 28.8 per cent. a Pneumothorax. b Cured spontaneously. c Children.

TABLE IX.—ULTIMATE RESULTS—CONTINUED.

Author, year	Cases	Mortality						Cured		Improved		With fistula	
		Medical treatment		Surgical treatment		Medical or surgical treatment							
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Lilienthal, 1920...	23			8	34.0			8	34.0	7	31.0		
McKinney, 1920..	3			1	33.3			2	67.0				
Whittemore, 1920 1921	17 21	1	5.8			5	16.0	3b	12.0				
Fisher and Cohan, 1921.....	5	2	40.0	1	20.0								
Lynah, 1921.....	38a												
Freyhan.....	65			20	31.0			37	57.0				
Lockwood, 1922..	27 27	3	11.0	11	41.0			16 13	59.0 48.0	3	11.0	3	11.0

a Pneumothorax. b Cured spontaneously.

[1] Includes cases reported by Clendening, von Eberts, Frank, Gregoire, Hawthorn, Izar, Paget, Simon and Swezey, Vargas, and Warthin.

present series it occurred only twice in 54 cases, even though the sputum was repeatedly examined. It should be borne in mind that necrotic processes in the larynx, trachea, bronchi, and pleuræ, may also produce elastic tissue in the sputum. The sputum on standing separates into three layers, the lower layer pus, the middle layer water, and the top layer foamy frothy mucus in which mucopurulent masses are suspended. Soft dough-like masses, usually excessively foul, the so-called Dittrich's plugs are often present, holding in suspension bacteria, particles of fat, fatty acid crystals, and epithelial débris. Particles of lung tissue and hæmosiderin may be present. Albuminuria, 1 on a scale of 1 to 4, usually develops in approximately one-half of the patients. Occasionally casts and epithelial débris are found. Diarrhœa is more a complication than a symptom and when present must not be considered lightly.

In certain cases, about one-fourth in my experience, the disease runs a peculiar recurrent course. Drainage does not occur freely from a bronchus or bronchi. The patients usually have an irregular course at the onset. Following the "bursting" of the abscess, the cavity is apparently emptied and patients begin to improve at once. Their sputum is less each day, their appetites improve, their aches and pains disappear, and they feel as though they are about to recover entirely. After a variable period, a few days or weeks, they begin to complain of increasing pain in the chest, an evening rise of temperature, perhaps headache and vague joint pains, and their appetites fall off. Chills and sweats may occur; often there develops a sense of fullness in the chest around the area involved, cough and dyspnœa increase, and again the abscess bursts. This type of abscess may run such a recurrent course for many months. Occasionally a small encapsulated empyema produces the same syndrome.

A thorough physical examination and a liberal interpretation of the findings are necessary. Signs of cavitation were elicited in less than one-third of our cases. Dullness on percussion and diminished breath sounds over the involved lung is the most constant sign. Large cavities may not be located on examination. On the other hand, a small superficial abscess that happens to be empty at the time may give the classical signs of a cavity. It is important to determine, by auscultation and percussion, whether the abscess is anterior, posterior, or lateral. It must be borne in mind that dullness on percussion, diminished breath sounds, and tactile fremitus may be due to the thickened pleura over the abscess or to empyema, encapsulated or free, as often as to consolidation of the lung. Important signs are, diminished excursions of the chest wall over the involved area, and retraction in the interspaces, usually present when adhesions are well formed and indicating a superficial abscess or at least extension of the inflam-

matory process. According to Norris and Landis, of 63 patients with abscess of the lung, definite physical signs were present in 8 only; in two-thirds the signs of cavity were entirely lacking or were not characteristic.

DIAGNOSIS

Diagnosis depends on the history, the roentgen-ray findings, examination of the sputum, and the general physical examination. An accurate history is essential, and on this alone the majority of lung abscesses may be diagnosed. The affection is three times as common in males as females. It may occur at any age, but occurs usually in early adult life, from 25 to 40 years. Thus it would seem that predisposing causes, such as exposure, excessive use of tobacco, alcohol, fatigue, and so forth, may play an important part. The location and extent of the lesion require a careful physical examination, but more especially, a thorough roentgenologic examination. Fluoroscopic examination and stereoscopic plates are essential.

The fluoroscope serves to rule out the presence of free or encapsulated fluid in the pleural cavity, the position and degree of movement of the diaphragm, the position of the heart and mediastinum, and affections of the aorta and mediastinum. Stereoscopic plates determine the location of the abscess, its extent, cavitation, the surrounding fibrosis or calcification, its position relative to the chest wall, whether single or multiple, and the presence of active or latent tuberculosis, carcinoma, syphilis, cysts, bronchiectasis, encapsulated empyema, massive gangrene, and foreign bodies. An empty cavity appears as a lighter shadow surrounded by a relatively dense shadow varying with the degree of inflammatory reaction, fibrosis, or calcification. The shadow is greater than the extent of actual necrosis. A fluid level in the abscess shows a horizontal line and the level shifts with the position of the patient. An air bubble may be present. Tuberculosis, bronchiectasis, and bronchopneumonia may be easily confused with abscess (Figs. 1 and 2).

In tuberculosis there is generally a characteristic mottling elsewhere in the lung, and especially at the apices, whereas pyogenic abscess rarely involves the apices and more commonly involves the lower lobes, particularly the right lower.

Apart from the history, bronchopneumonia may be determined by a shadow of more uniform density and no cavitation.

Bronchiectasis is a diffuse process and the bronchial shadows are more extensive and radiate from the hilus. Moore has pointed out the necessity of having the patient empty the chest before raying, particularly in the cylindrical and sacculated types.

Gangrene casts a denser shadow, usually more extensive, with irregular areas of varying density producing a coarse mottling effect.

In malignancy roentgenograms vary depending on whether the lesion is primary in the hilus, is lobar or miliary in type, or is a metastatic nodular or miliary type. Carman, in exhaustive articles on pulmonary malignancy, has pointed out that the diagnosis of pulmonary malignancy is nearly always possible from the plates, but that in certain cases, the patient's history and physical examination must be considered. In primary cancer the shadow is of more uniform density, is more sharply outlined and is regular. While there may be a hazy area of infiltration around the growth, it is different from that due to inflammatory reaction. Smaller shadows of local metastasis are usually present. Metastatic malignancy of the nodular type might occasionally be mistaken for multiple abscesses. The shadows are denser, more widely scattered; the extension is peripheral, and usually involves both lungs. The apices are rarely involved.

Sarcoma presents a uniformly dense shadow, more regular and sharply defined than abscess.

Echinococcus cysts or dermoids present sharp, circular, well-defined areas of increased density, usually in the right lower lobe. Pneumoconiosis (anthracosis, cholicosis) presents a different picture. There are scattered fine mottlings, distributed symmetrically throughout both lungs suggesting miliary tuberculosis, but not borne out by the history. They may be in upper lobes particu-

larly but the apices are not usually involved. It may be difficult to differentiate from fibroid phthisis.

DIFFERENTIAL DIAGNOSIS

The following must be ruled out: Lung abscess due to tuberculosis, diffuse gangrene, bronchiectasis, empyema with a bronchial fistula, encapsulated empyema, interlobar empyema, unresolved pneumonia, purulent bronchitis, diffuse peribronchial lymphangitis, abscess of the mediastinum, syphilis, cancer of the lung or mediastinum, ecchinococcus or dermoid cysts either in the lung, mediastinum, pericardium, or diaphragm, and aneurism of the aorta. The sputum should be repeatedly examined for the bacilli of tuberculosis. Apart from the history, one must rely mainly on the roentgen-ray to differentiate these conditions.

Needling of a pulmonary abscess as a diagnostic method is mentioned only to be condemned. Lord points out: "Exploratory puncture is an unjustifiable method that cannot be too strongly condemned." Murphy, Lillienthal, and Eisendrath agree. Sudden death due to pleural syncope or to cerebral emboli may occur. Empyema results in a certain percentage. Troublesome superficial abscess may develop. A blood vessel may be injured and bleed freely.

It has been suggested that the bronchoscope should be used as an aid to diagnosis. Personally I can see no reason for submitting a patient to such examination unless there is a possibility of the patient having aspirated something. I would advise against its use in extensive abscess where flooding of the same bronchial tree or the opposite with foul pus may result. In any case, it is extremely rare that a definite cavity can be visualized through a bronchoscope. A bronchus leading from the cavity and discharging pus is usually all that can be seen.

COMPLICATIONS

The complications of pulmonary abscess vary, particularly with the etiology, and may be more serious than the disease itself. With practically all superficial abscesses there is an adhesive pleuritis with a matting together of the parietal and visceral pleuræ. Occasionally a serous pleuritis develops which may later become purulent (empyema). The presence of pleuritic adhesions varies: Picot, in 149 pneumotomies, found them in 53 per cent, Tuffier in 87 per cent. In 5 only of 35 cases from the Massachusetts General Hospital (Lord) were the lungs free. McRae, in 75 collected cases, reports adhesions present in 85 per cent of acute cases and in 81.3 per cent of all cases.

Occasionally localized bronchiectasis surrounds the abscess, and may extend to the hilus. Conditions as follows may develop: arthritis, endocarditis, pericarditis, subphrenic abscess, mediastinitis, brain abscess, septicæmia, pyæmia, amyloid disease, diarrhœa, gangrene, and hæmorrhage. Hæmorrhage is a dangerous complication. Lord had one death in 50 patients. Patschke, Kraus, Garré, Tuffier, Westbrook and Lockwood each had a death from hæmorrhage (a small pulmonary arterial aneurism or artery rupturing in the cavity). Repeated severe hæmorrhage greatly reducing the patient's resistance and ability to combat the disease is a serious complication.

Cerebral abscess is a grave complication. Martius, in 1891, collected 22 cases at necropsy. Cameron, in 1907, found 17 cases, Hedblom found 2, and Fabricant 1. Hamman believes that brain abscess is a common sequela. We have recently observed 3 patients with brain abscess, 1 recovered and 2 died. These cerebral lesions are due to detachment of infected emboli from thrombi in the pulmonary veins; they are more often multiple than single and produce a syndrome of Jacksonian epilepsy. They may produce hemiplegia or monoplegia, loss of vision, persistent headache, psychosis, and ultimate death. The left side of the brain is most often affected.

Diarrhœa is a complication or perhaps more properly a late symptom of a systemic involvement and calls for urgent investigation. Proctoscopic examination should be made and every means taken to determine the cause. If diarrhœa persists and the patient is not holding his own, the abscess should be operated on. Unfortunately, it is very often

a late evidence of pyæmia, and even though the abscess may clear up, the patient dies of the diarrhœa and general weakness. Necropsy may reveal minute ulcerations in the intestine but often only an inflammatory and irritative congestion.

PROGNOSIS

The prognosis depends on the cause, the extent of the lesion, the general resistance of the patient, and the treatment. The extreme toxicity of emulsified tissue in pulmonary abscesses and even of normal lung tissue has been shown experimentally (129, 194). The prognosis is more favorable in abscesses following lobar pneumonia and trauma.

Abscesses following tonsillectomy are more favorable than those following aspiration of foreign bodies such as pieces of metal, kernels of corn, and so forth. Metallic bodies particularly seem to have some inherent property of producing gangrenous abscesses. Abscesses due to bronchopneumonia are so often multiple that the prognosis is not favorable. If due to direct extension from the liver or subdiaphragmatic space the prognosis is fair, whereas it is bad if the extension has been from the mediastinum. If they are due to metastasis from distant foci, the prognosis is bad. It is very much better in acute than in chronic abscess, and in single than in multiple. Apical abscesses are more favorable than those located in the lower or middle lobes because the former drain more easily into the bronchus. It is, of course, better in multiple abscesses confined to one lobe or lung than in those involving both lungs. The prognosis must be guarded when hæmorrhage, even if only a trace, has occurred.

Less than one-fourth of the acute single abscesses will require surgery. Early operation for acute multiple abscesses is not warranted. Possibly one-third of the chronic single abscesses and one-half of the chronic multiple abscesses confined to one lobe may require operation. It is rare that a patient with either acute or chronic multiple abscesses involving both lungs is in a condition to stand operative treatment. In 3 such cases I have been obliged to operate because the main abscess attained such a size that the patients were *in extremis*. Two survived but were cured only partially. Perhaps early pneumothorax on the most involved side would give a better chance for relief in these bilateral cases.

The small encapsulated abscesses that are not connected with a bronchus should be carefully watched, and, if the patient continues to show signs of absorption, either pneumothorax or operation should be undertaken. Such abscesses act as dangerous foci of infection and the gravest sequela may follow absorption of pus from them. The prognosis should be guarded. All abscesses, due to a foreign body in the parenchyma and those to a foreign body in a bronchus that cannot be removed through a bronchoscope, should be operated on.

MEDICAL TREATMENT

Mix says: "There is no medical treatment for pulmonary abscess." Goldberg and Biesenthal say: "The treatment of acute lung abscess by medical agents, pulmonary inhalant antiseptics, posture and the like, carries with it so high a mortality and at best only an amelioration of symptoms with very few cured, that it might better be discarded for some surgical procedure."

Robinson says: "I early learned the necessity for expectant treatment in these cases." I would like to add a fervent amen to this last statement. Tuffier and Murphy both say that if the abscesses are draining freely through a bronchus, medical treatment should be thoroughly tried. Before any operative interference is considered, I believe practically every patient should be given a thorough trial on medical treatment as follows: rest in bed in the open air, frequent feedings of highly nourishing foods, such as milk, eggs, gelatins, custards, chocolate, cocoa, and so forth, and sodium bicarbonate from 100 to 120 grains in 24 hours to offset acidosis. The glycogenic function is reduced in all patients who have for some time been subject to active suppuration. To improve this, one glassful of 5 per cent glucose in water should be sipped every 2 hours during the day; postural drainage must be encouraged. Persevere with such patients until some position is found in which

free bronchial drainage is established. Once such a position is found, carefully explain to the patient the necessity of keeping the abscess free of pus and, as often as his general condition will permit, have him assume the posture. Particularly the last thing at night and the first thing in the morning, and during the night if he awakes he should attempt to evacuate the pus. Case 1 illustrates successful medical treatment for this condition.

Inhalations should be employed, not so much for their curative effect *per se* as to offset the odor, thereby improving the patient's mental outlook, and his desire for food. Stimulant cough mixtures may be taken. If there has been a hæmorrhage the patient's bleeding and coagulation times should be ascertained; if they are delayed, calcium chloride should be given intravenously.

The use of the bronchoscope has been advised by Meyer, Lynah, Jackson, Mayer, Mosny and St. Girons, Yankauer, and others. It has been employed to irrigate the cavity, to aspirate the pus and instill antiseptics, and merely to dilate the main bronchus leading from the abscess to allow spontaneous healing to occur. I do not believe that the use of the bronchoscope can be relied on as a routine method of treatment. Certainly every effort should be made to remove foreign bodies through it and many abscesses heal after the foreign body has been removed. It is possible that dilatation of the main discharging bronchus by establishing free drainage would increase the percentage of medical cures. I have always feared the possibility of infecting the healthy lung during manipulations with the bronchoscope and have preferred to avoid every possible measure that might allow the patient to aspirate pus into the healthy lung.

A four-hourly temperature chart should be kept and the patient watched carefully from day to day. So long as his general condition improves, nothing further should be done. If after a fair trial of this method, the temperature is still maintained, and the patient is not eating better, is not sleeping better, is having fever, or is not gaining in weight, and the amount of sputum persists, other measures should be considered.

Artificial pneumothorax should be employed in certain types of abscess. Tewksbury, Goldberg and Biesenthal, Bazin and others report favorable results. I must confess that I have had little success with it. However, with a patient that is having severe hæmorrhage from a lung abscess, pneumothorax should be resorted to at once. If the abscess is small and well localized, I would employ pneumothorax. If, on the other hand, the abscess is large or multiple and the patient is producing a considerable quantity of pus, unless the condition is long standing and the lung over a wide area is probably firmly adherent to the chest wall, pneumothorax may do harm. When there is extensive necrosis of the abscess, the adhesions may tear away from the chest wall, pus will escape into the pleural cavity, and empyema result. In other cases it is conceivable that the collapse of the lung in a patient already emaciated and with little resistance might be attended with danger from syncope and from the exhaustion of the irritative cough that sometimes follows pneumothorax. In cases of small encapsulated abscesses without bronchial connection, pneumothorax should certainly be tried before surgery is instituted. In any case, so long as the patient is not holding his own or improving after the lung has been collapsed, surgery should be undertaken.

INDICATIONS FOR OPERATION

1. Operations should be undertaken for all patients who, after a thorough trial of medical treatment, are no longer improving or holding their own.

2. Early operation is advisable in all cases of fair-sized patent cavities surrounded by markedly fibrosed or calcareous walls.

3. Pneumothorax may be advisable in all cases of small, completely encapsulated abscesses not connected with a bronchus. If pneumothorax does not improve the condition, operation should be undertaken early.

4. After thorough medical treatment to put the patient in the best possible condition for operation, surgery should be resorted to in all cases in which an abscess surrounds a foreign body imbedded in the parenchyma,

or in which a foreign body in a bronchus cannot be removed through the bronchoscope.

5. Early operation is advisable for patients with very large abscesses even though the patient's general condition is fairly good, since there is a possibility that they will be drowned in their sputum.

6. There is a small percentage of patients who have developed very large abscesses and whose general condition is very bad, in whom drainage is urgently necessary, regardless of the great risk, because they produce such quantities of pus that they are in danger of drowning themselves.

Various methods have been employed for securing drainage. The earlier surgeons resorted to intercostal stab, cautery puncture, or trocar drainage through an interspace. Because they were not always successful in reaching the cavity through the interspace, resection of the overlying ribs was resorted to. The necessity of having firm adhesions over the abscess has been insisted on before attempting to drain the abscess. If adhesions were not present, irritating pastes, gauze packs, and suturing of the parietal pleura to the visceral have been resorted to in order to establish adhesions. In this connection, if any measures are to be employed to establish adhesions, I prefer a gauze pack. After freeing the parietal pleura sufficiently, the pack is placed and the skin flaps sutured over the gauze and left in place for from 4 to 8 days. There are certain objections to the suture method.

Very often the patient coughs, the needle tears a little in the parietal pleura, and the lung collapses. It is an easy matter to get the lung into expansion again but occasionally the surgeon overlooks the fact that the lung has collapsed and leaves it in collapse. I have seen surgeons in passing their needle through the lung open into the abscess, and I am sure empyema must have resulted in most of those cases. Distressing, even almost fatal, emphysema has occurred. On the whole, suture is unnecessary and prolongs the operation needlessly unless there is some urgent reason for opening the abscess at the first operation. If the patient is acutely ill, and drainage is urgent, it is much safer to drain an abscess through an area that is firmly adherent to the chest wall and the quickest and safest method of accomplishing this should be employed. However, the majority of patients with lung abscess stand operation well. I have found that a more deliberate and extensive operation than the ordinary resection of the overlying chest wall and drainage gives a better ultimate result with scarcely any additional immediate risk to the patient.

With all our methods of localizing and outlining abscess or abscesses in the lungs, I early realized that at operation hidden pockets or adjoining but distinct abscesses were often overlooked and only revealed at necropsy. While the stereoscopic plates and the fluoroscope are invaluable in localizing such abscesses, we could never be sure in the old operation that all areas were being drained. The exploratory needle is highly unsatisfactory and unreliable. It is many years now since physicians became convinced that in abdominal abscesses exploratory laparotomy was less dangerous than exploratory puncture. All physicians who have had experience with a number of thoracic cases must feel that the same is true in indeterminate thoracic lesions. I have not employed the needle for diagnostic purposes during the past 4 years except as a means of determining the nature of pleural collections.

Because of the uncertainty of localization of an abscess in the lung, because with the earlier operation through the adherent area of the abscess I had not drained all pockets, and because thoracotomy under local anæsthesia is so safe a procedure, I prefer to open the thorax widely, thoroughly palpate the lung and locate the abscesses, and establish drainage accordingly. The thorax can be opened and its contents explored as readily and with as little risk as the abdomen. Apart from those patients who are acutely ill, I prefer that adhesions be absent or at least be so few and so recent that they can easily be broken down if need be. A few adhesions act as a guide to the involved area of lung. Wills, in 1901, operated on 2 patients by opening the thorax widely, palpating and accurately locating the abscess, and draining. Murphy, in discussing Wills' paper, favored the operation. Ashhurst

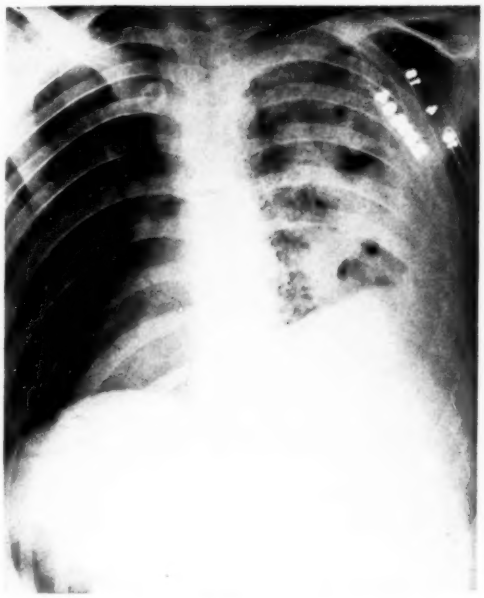

Fig. 1. (A239564.) Multiple cavities.

Fig. 2. (A217107.) Fluid in the right thorax; bilateral tuberculosis.

advised the same procedure, that is, wide exploration, palpation, and drainage. Except in patients so acutely ill that drainage through the adherent area was the limit of judicious surgery, the operation which I have employed for the last 3 years is as follows:

After the location of the abscess has been determined as accurately as possible, whether anterior, posterior, lateral, high, or low, peripheral or deep, the incision is planned so that the skin flaps completely expose the abscess and yet can readily be employed to close it ultimately. Beck showed the value of flaps in the closure of cavities following abscesses and empyema. For reasons that I have repeatedly pointed out, in my opinion, paravertebral anæsthesia associated, if necessary, with gas and oxygen, is the anæsthetic of choice in all thoracic surgery. The incision is made, if possible, in the first interspace below or above the adhesions or abscess. The intercostal incisions allowing easiest access to abscesses are: (1) the third or fourth interspace for abscesses in the anterior portion of the upper lobe, (2) the fifth interspace, carrying the incision posteriorly from the nipple line for an abscess in the middle lobe, and (3) the seventh or eighth interspace, carrying the incision posteriorly from the anterior axillary line for an abscess in the middle lobe (Fig. 3).

Occasionally, it is necessary to approach an abscess through the posterior aspect of the chest. It is usually possible to obtain sufficient room between the vertebræ and the scapula. If necessary, the scapula can easily be winged outward or inward without any permanent disability, if the muscles are properly sectioned and transplanted or repaired and if fixation is avoided by moving the arm and shoulder from the first. The typical intercostal thoracotomy is employed and the interspace opened sufficiently wide freely to admit the operator's hand to search for adhesions; if present they lead to the main abscess. The hand is swept over the lung, feeling for areas of hardening or softening. The hilus glands and the mediastinum are palpated. The experienced operator in a moment will detect changes in the consistency of the lung. When the extent of involvement is determined the

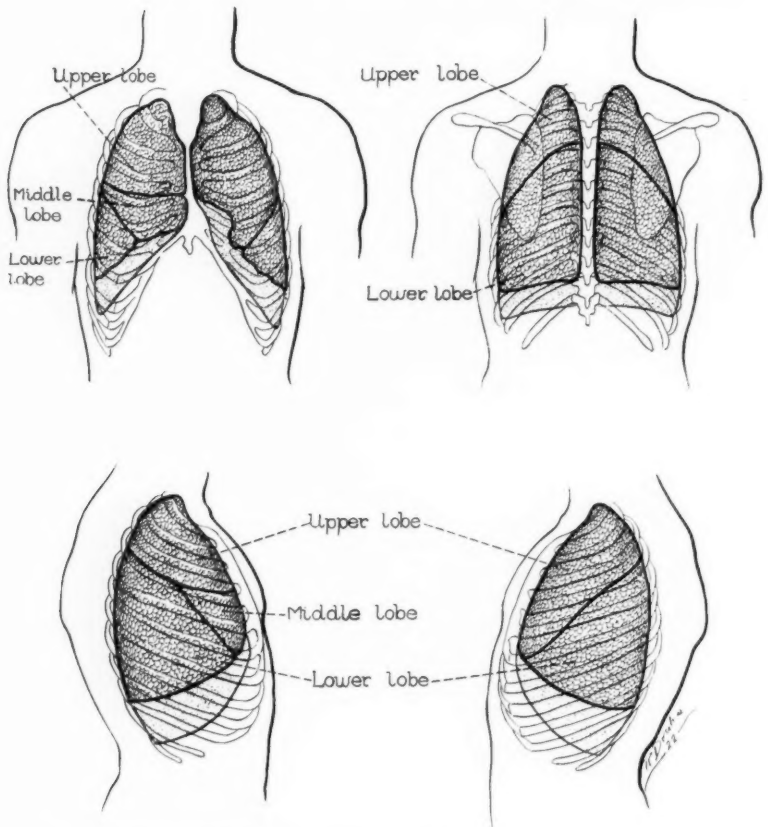

Fig. 3. Diagram of lungs showing the position of fissures in relation to the chest wall.

lung is brought up to the chest wal so that the involved area will be most easily exposed. The site of this is mapped out on the chest wall and flaps fashioned to expose that portion. After a sufficient amount of the chest wall has been removed, the lung is brought up and delivered through the opening so that the outer wall of the abscess is well outside the level of the chest wall (Fig. 4). It is then sutured there with twenty-day catgut. The first row of sutures includes the visceral pleura, the parietal pleura, and the intercostal muscles. A shoemaker stitch is employed and the first row of sutures should so closely appose the parietal pleura to the visceral that the pleural cavity is entirely shut off. If there is sufficient muscle available, and there usually is (either the pectorals, latissimus dorsi, or serratus magnus as a rule), a second row of sutures approximates the muscles to the visceral pleura over the first layer. A third row sutures the skin to the visceral pleura so as to overlay the second row and doubly overlay the first row (Figs. 5, 6, 7, and 8). If the abscess is very large and the patient has been producing a large amount of sputum by coughing, it may be wise to rub vaseline into the suture area and open the abscess at once. I have had one patient drown in his own sputum after the first stage and before the abscess was opened.

In most cases it is wiser to wait 3 to 4 days until granulations have formed. No anæsthetic is necessary to open the abscess. The entire

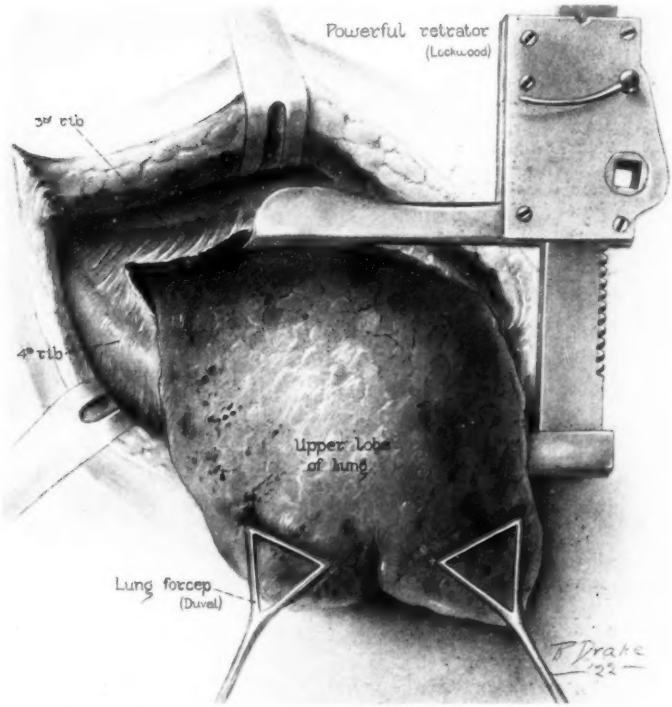

Fig. 4. Exposure of the upper lobe through an intercostal incision.

top of the abscess is excised with a scalpel; the cautery is not employed until the cavity is thoroughly exposed, all débris removed, and all tags cut away and ramifications of the abscess opened. The cautery gives a false security. Fair-sized vessels often are found in the walls of abscesses. The cautery sears them over temporarily and in the presence of infection or necrosis they may later open and bleed. It is safer thoroughly to expose the abscess with a knife or scissors, employ hot packs to control the bleeding and after thoroughly cleaning out the abscess, tie off the larger vessels and, if necessary, apply the cautery here and there to control oozing. Crush all bronchi and tie with catgut. It may be advisable at the first operation to dissect out, invert, and suture over larger bronchi (Fig. 9). After the cavity is thoroughly dry, pack it with gauze wrung out of glycerin and saline. (Sodium chloride 5 per cent, sodium citrate 0.5 per cent, glycerin.) This is a soft, bland dressing that is non-irritating, does not allow the gauze to become adherent, and sets up a mild osmosis from the surface of the lung. After 4 days the pack is removed, all tags are snipped away with scissors and a similar dressing carefully applied. Daily dressings are discouraged and every effort is made to avoid reinfection or additional infection. At the earliest possible moment, skin flaps are brought in to overlay and close the cavity. Usually by the tenth day this is possible. If all bronchi are closed the flaps will adhere more readily. Smaller bronchi may be cauterized within their lumen to the depth of 1 to 2 centimeters and the flaps applied directly over them. Even in the presence of considerable suppuration, flaps readily adhere and granulate into the lung tissue. A light pack of glycerin and saline is applied over the flaps to keep them uniformly adherent, and the

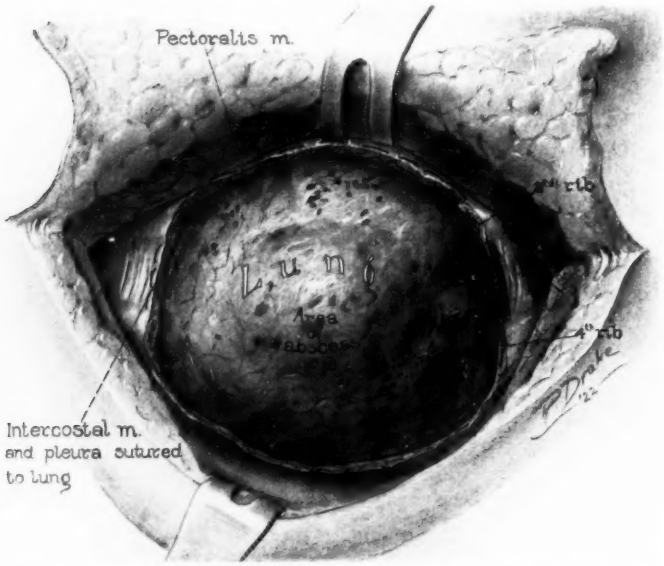

Fig. 5. Suture of the parietal pleura and intercostal structures to the lung.

dressing is left in position for 4 days, by which time the flaps are usually securely attached. By this method the danger of secondary hæmorrhage is reduced, the tendency to reinfection is lessened, and the repeated dressings and the long drawn-out convalescence of the old operation are avoided.

Whether the abscess is drained through a small opening in the adherent area or is widely opened, as I have suggested, irrigation of the cavity should never be practiced. Violent coughing often follows irrigation and infective particles may be carried to distant bronchi in the same lung or in the uninfected lung. In abscesses that have been opened by cautery puncture or blunt dissection, a few drops of 2 per cent formaldehyd in glycerin may be instilled through a catheter. It is hydroscopic, mildly antiseptic, and deodorant.

Resection *en masse* is possible in many small completely encapsulated abscesses. It is the operation of choice in a small abscess surrounding a foreign body imbedded in the lung. If the patient is producing sputum, there is a surrounding bronchiectasis or an open bronchus, and complete resection is not advisable.

Tuffier practiced an operation whereby the parietal pleura was freely separated from the chest wall and fat transplanted over it to exert sufficient pressure to collapse the abscess. Archibald has employed this method in apical tuberculous cavities. I believe this operation should be reserved for the latter type of case.

POSTOPERATIVE TREATMENT

Treatment after operation is important. The patient should be nursed in the open air, and forced feeding and the administration of alkalis and glucose should be continued. Patients should be advised not to swallow sputum; many patients do this unconsciously. As soon as the temperature falls to normal, the patient should be up and around; he should do light setting-up exercises and every possible means should be employed to get him back to health. If bronchial fistulæ have persisted, their early operative closure should not be attempted. It must be determined by the roentgen-ray and careful examination that there is no hidden pocket or area of necrosis left to maintain the patency of the bronchus, and then, apart from cauterization, no active

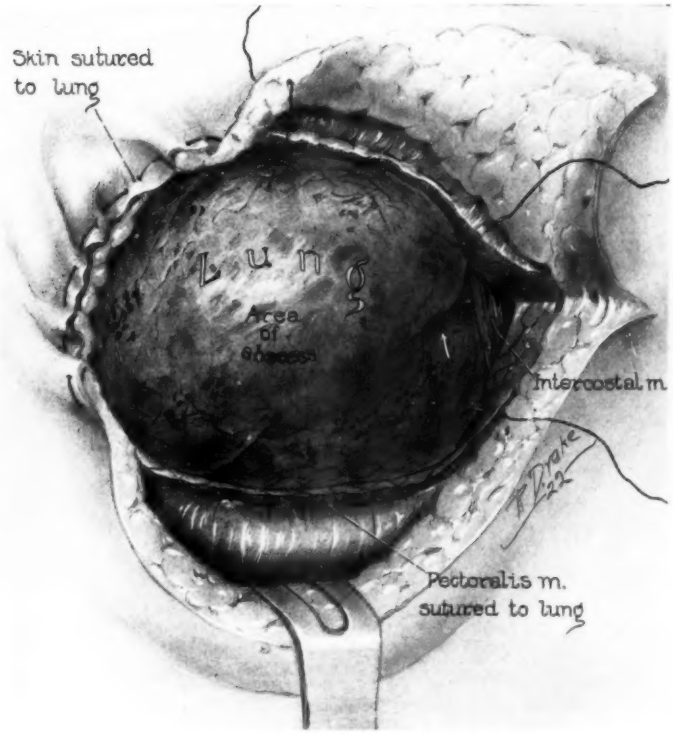

Fig. 6. Three rows of sutures on the left lung: first, intercostal structures; second, pectoral muscles; and third, skin.

measures or closure should be thought of until the patient is in good health. Conditions in the chest, such as bronchial fistulæ, small intrapulmonary cavities, or small empyemal cavities, should not be tampered with, unless some good purpose is to be accomplished. Cerebral lesions and sudden death occur too often following such palliative measures. Plan, if possible, to do all that is necessary in one operation. For the first year or two, patients should be warned to avoid exposure, as they have a greater tendency to colds and pneumonia.

Codein or heroin in small doses may be necessary to control the troublesome cough that is sometimes more frequent for the first few days after operation. Heroin should be cautiously used, however. The patient in his exhausted condition may go to sleep and sleep for 11, 12, or 18 hours. If the cough has been completely controlled, a large quantity of pus may collect and in a violent coughing spell, the patient may be choked with pus, and aspirate large quantities into all parts of his lungs, and even drown himself. Case 2 illustrates the danger of this treatment.

POSTOPERATIVE SEQUELÆ

Emphysema, sepsis, septicæmia, empyema, grave pneumonia, cerebral embolism, and severe hæmorrhage may follow operation. Emphysema is not a common sequela, but it does occur. Its treatment is expectant. Sepsis as a rule is confined to the adjacent skin edges, and is not serious, unless septicæmia develops. Staphylococcus pyogenes albus or staphylococcus pyogenes aureus particularly, and occasionally the streptococcus hæmolyticus are found in the blood of most patients who develop septicæmia from abscess of the

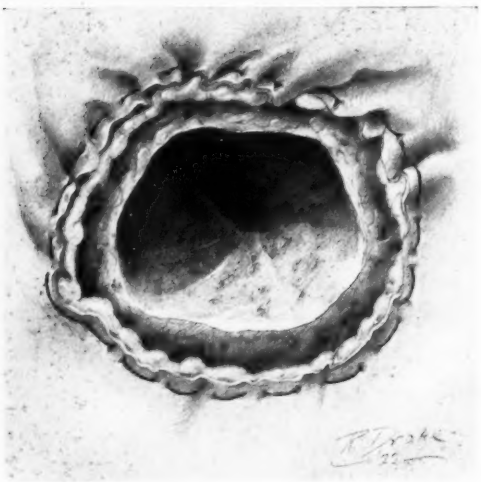

Fig. 7. Cavity of abscess and skin suture covering the first two rows of sutures.

lung. Empyema is a serious sequela and must be drained or dealt with by aspiration, regardless of the presence of the abscess. Empyema on the opposite side is a very grave complication and, if possible, should be dealt with by repeated aspiration. Pneumonia following operation for lung abscess is more often bronchopneumonia, but may be lobar. It is usually severe and the majority of deaths following operation, apart from those due to the shock of the operation itself, are due to pneumonia. Cerebral embolism, unfortunately, occurs from time to time and follows the same course as described under complications. Severe hæmorrhage occurs in a certain percentage of postoperative cases. Of 74 patients operated on by Tuffier, 4 bled to death. Patschke, Kraus, Garré, Green, and Lockwood have all reported deaths from postoperative hæmorrhage. I have not, however, had a death since I adopted the precaution of encircling the base of the

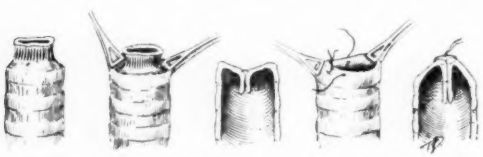

Fig. 9. Steps in the closure of a bronchial fistula.

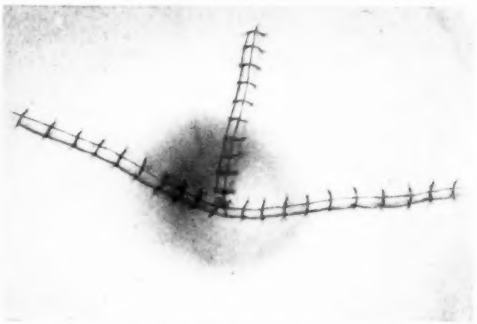

Fig. 8. Flap imbedded in the abscess cavity.

abscess with purse-string sutures of twenty-day catgut, and tying all vessels. Small pulmonary arterial aneurisms occur in the processes of necrosis and cavitation, and care must be taken to ligate behind the cavity.

MORTALITY AND RESULTS OF TREATMENT

The mortality varies with the age of the patient, the cause of the disease, the extent of the lesion, the patient's previous general condition, and the treatment and general care (Table IX).

The death rate in children varies from 21 per cent as stated by Bassin, in 19 children, to 100 per cent as quoted by Baron in 7. Children and adults past middle life do not tolerate lung abscess well. Apparently the surgical mortality in children has been approximately 60 per cent, and the medical mortality 85 per cent. The mortality rate in children with acute single abscess should be less than 12 per cent, with thorough medical régime combined with pneumothorax if necessary. On the whole, the number that will be multiple, those that become chronic, and those that demand surgery, will raise the mortality to nearer 40 per cent.

In adults the death rate after medical treatment has averaged 58 per cent, after surgical treatment 35 per cent, and after medical treatment and pneumothorax 16 per cent. These percentages, however, cannot be translated literally to represent the true death rate. A careful study of the reported cases shows a wide variation in the selection of patients for treatment by medical régime, pneumothorax, and surgery.

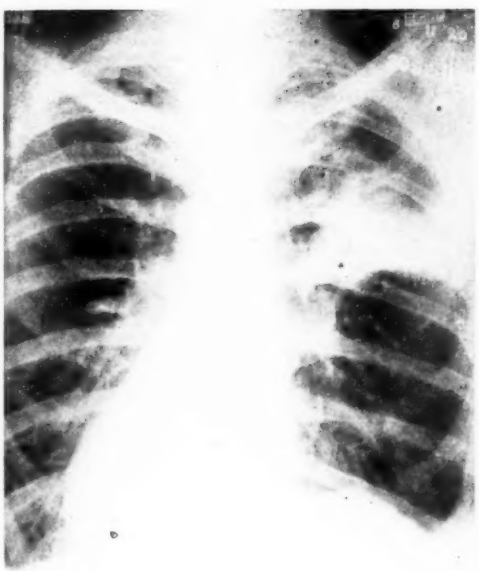

Fig. 10. (A303512.) Abscess of the right upper lobe of the lung.

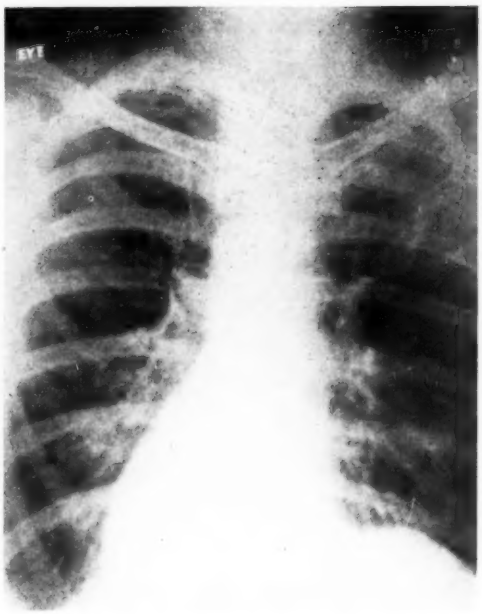

Fig. 11. (A303512.) Healed abscess, 3 months after roentgenogram in Figure 10 was taken.

Balboni reported two cures in 4 cases; Tewksbury reported six cures, two improvements, and two deaths in 10 cases following pneumothorax; and Goldberg and Biesenthal reported twelve cures, two improvements, and two deaths in 16 cases following pneumothorax.

On the other hand, Picot reported only 10 per cent of 133 patients cured with medical treatment; McKechnie reported one cure, and Rendleman one; Wessler and Schwarz reported that one-third of thirty postoperative abscesses in children cleared up spontaneously, and Clarke and Marine reported 4 of 31. Whittemore said that only from 6 to 10 of 100 patients get well without operation and of 21, 3 recover spontaneously. Kraus and Strauss reported spontaneous cures. Of 20 patients with abscesses due to lobar pneumonia seen by Laennec, 18 recovered after medical treatment. His editors, however, doubted the diagnosis in certain cases. McKinney reported 1 of 3 patients spontaneously cured. Holmes reported 1 case of his own of multiple abscesses in which the patient recovered on medical treatment; he collected 2 other such cases. Wessler reported 6 of 8 patients with abscesses cured, the duration of the abscess was not less than 3 weeks and not more than 6 months. Wasmer had six medical cures. Yankauer reported three cures in 15 cases with bronchoscopic treatment, and Lynah, Mayer, Mosny, and St. Girons, report cures by such treatment.

Of 1117[1] patients with abscess of the lung, 518 (46 per cent) are reported cured; 161 (14 per cent) improved, 17 (2 per cent) improved but with a persisting sinus, 48 (5 per cent) not improved, and 373 (33 per cent) dead. The average medical mortality was 58.6 per cent. The average surgical mortality was 34.6 per cent.

These data, while interesting, distort the facts. Forty-six per cent of patients cured is higher than the average has been in the hands of careful observers who have a thorough follow-up system. Lord states that

[1] Includes cases reported by Clendening, von Eberts, Frank, Gregoire, Hawthorn, Izar, Paget, Simon and Swezey, Vargas, and Warthin.

Fig. 12. (A231963.) Putrid gangrenous abscess of the right upper lobe.

only 16 per cent are cured by surgery. I believe that many reported cures in the collected cases would have been more properly listed as improved. Again, 2 per cent improved but with fistulæ, is 2 per cent of the whole, but 11 per cent of those treated surgically.

In considering the mortality and results of treatment, I wish to direct attention to this group of 54 patients and particularly to the 27 treated medically. These cases were, on the whole, long standing and serious. Forty-nine were chronic; the average duration of symptoms was 19 weeks before examination. Twenty-five were of the type usually classed as gangrenous abscess. In 16 the complications were almost as serious as the disease itself. Of the 27 patients treated medically, 16 are cured, 3 improved, 5 not improved, and 3 dead. Of the 5 patients not improved, in 1 the diagnosis is uncertain. It may be a sarcoma, the patient is still under observation; in 1 the patient has multiple abscesses, is extremely ignorant, and refused to stay for treatment; in 2 there is extensive associated bronchiectasis; in 1 the patient attempted to carry out the treatment at home. Of the 27 patients treated surgically, 13 are cured, 3 improved with fistulæ, and 11 are dead.

An analysis of the 11 deaths shows the extent of the disease before coming for treatment, and the impossibility of averting death in a certain percentage of late neglected cases.

The results are certainly better when the patients are hospitalized and under the constant care of a close observer. If medical treatment alone, or medical treatment with pneumothorax, is instituted, the patient must be carefully watched every day for signs of increasing toxic absorption. The signals must not be missed, nor the opportune moment for surgery. The greatest danger in medical management of these patients is that often the time is not recognized when medical treatment should give way to surgical; for that reason, once the condition has been diagnosed, the patient should be under the care of the surgeon, as well as under the constant attention of the internist.

ILLUSTRATIVE CASES

Case 1. (A303512.) Mr. F., age 59, on whom a radical Killian operation had been performed, developed a cough on the second day. The sputum became thick and foul, and progressive weakness and loss of weight followed. Pain developed in the right chest. There was some dyspnœa. The hæmoglobin was reduced to 55 per cent, the erythrocytes to 3,220,000, and the leucocytes increased to 14,800. Examination of the sputum did not reveal elastic tissue or tuberculosis bacilli. Roentgenograms showed an abscess of the right lower lobe. A slight retraction over the third space in front, cavernous breathing, cracked-pot sound and whispered pectoriloquy over the second and third interspaces in the middle clavicular line were noted. A diagnosis was made of abscess in the upper right lobe of the lung. Forty days after the abscess developed, the patient was placed on medical treatment and postural drainage. During the first 7 weeks he gained 30 pounds. His cough cleared up rapidly, but he maintained an evening temperature. After 13 weeks of treatment he returned to work entirely well. In answer to a questionnaire 15 months later he said he was in "perfect health" (Figs. 10 and 11).

Case 2. (A321963.) Mr. A. H., age 56, registered at the Clinic June 26, 1920. He had been well until September, 1919, when he developed severe influenza from which he never entirely recovered. He was

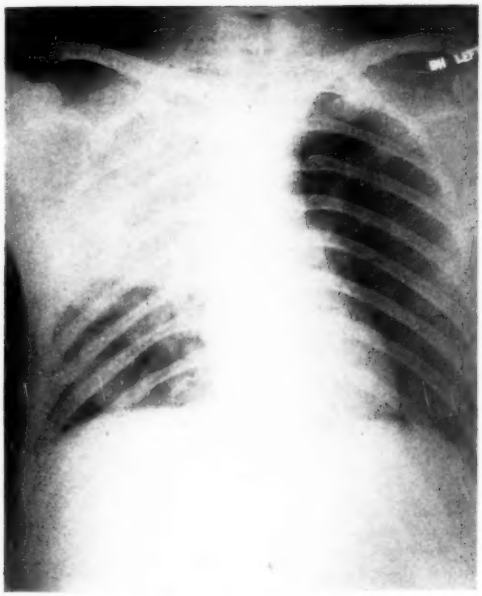

Fig. 13. (A360675.) Abscess of the left upper lobe.

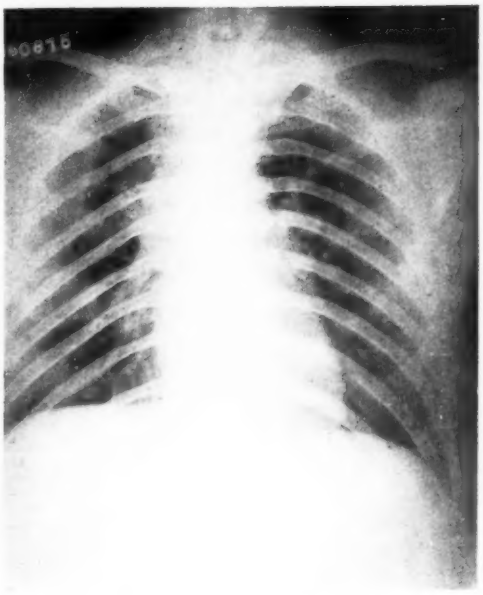

Fig. 14. (A360675.) Healed abscess 37 days after roentgenogram in Figure 13 was taken.

able to work and be around. In March, 1920, he had a bad cold. His cough increased, he lost appetite and strength. He began to have a daily temperature of 99° to 102° with occasional chills. About the third week the sputum increased in amount and became so foul that the family could not stay in the room with him. He coughed up half a cupful at a time and large quantities in 24 hours. Posture did not increase the amount of sputum; he spat up some blood from time to time. Later he developed pain over the right chest anteriorly. He perspired profusely at night, and became so weak that he was confined to bed. He had lost 40 pounds in weight.

The abscess had been well established for 3 months when he was brought to the Clinic. He was pale, emaciated, extremely weak and had a frequent racking cough. He produced large amounts of extremely foul sputum with each coughing spell. He had marked clubbing of the fingers, and watch crystal nails. He was dyspnœic and had pain continually over the right chest anteriorly. His hæmoglobin was 63 per cent, erythrocytes 3,640,000, and leucocytes, 17,800. The sputum was negative on repeated examinations for tuberculosis bacilli and elastic tissue. Marked retraction over the second and third interspaces on the right side anteriorly was noted. There was an irregular area over the second and third spaces or impairment on percussion, moist râles, whispered pectoriloquy, increased breath sounds, a suggestion of a cracked-pot sound, and a surrounding area of consolidation. Roentgenograms revealed an extensive abscess of the right upper lobe (Fig. 12). A diagnosis of putrid abscess of the right upper lobe was made. The patient was so exhausted by his trip to the Clinic that while operation was urgently indicated, it was considered necessary to put him at rest on routine medical treatment to improve his general condition. He was kept in bed in the open air for 4 days, glutted with highly nourishing food, sodium bicarbonate (120 grains in 24 hours), glucose by mouth and by rectum. He improved greatly in the 4 days and operation was undertaken.

Paravertebral anæsthesia was employed. The thorax was opened through the fourth interspace. The upper and middle lobes were firmly adherent to the chest wall anteriorly and laterally as far as the postaxillary line. The upper and middle lobes felt solid, like a neoplasm. However, the adhesions were so firm that palpation was limited. A portion of the third rib was excised and the visceral and parietal pleura sutured well below the area of lung involved. The upper skin edge was sutured back, the abscess to be opened 48 hours later. Because of the particularly distressing cough, the interne was instructed to give one-twelfth of a grain of heroin at intervals of one and one-half hours until the cough was under control. After three one-twelfth grain doses over an interval of 6 hours had been given, the patient went to sleep at 11 p.m. and slept until 10 a.m. without coughing. He had been in the habit of coughing violently at least every 20 to 30

minutes at night. At 10 a.m. he awakened, complained of pain over his chest, moved a little and began to cough. A large amount of foul pus gushed from his mouth; he gagged and choked and became intensely dyspnœic. The interne was called at once and believed the patient had developed a pulmonary embolus. On being called, I was satisfied that he had aspirated a large quantity of pus and was drowning himself in it. He was extremely dyspnœic and cyanosed; breathing was very labored, and he died shortly after. Necropsy revealed extensive large multiple abscesses approaching a localized sacculated bronchiectasis. The bronchial tubes in both lungs were full of thick, foul pus containing much epithelial débris, shreds of lung tissue, and calcareous particles.

Three mistakes had been made in the treatment of this patient.

1. Although he was extremely ill and the area of involvement was extensive, he improved remarkably in 4 days of active medical treatment. He should not have been operated on until the maximal improvement had been reached.

2. If patients have extensive cavities, produce large quantities of sputum, and are acutely ill, drainage is the prime object in operating, and should be secured by the quickest and most direct method. Following operative interference with the pleura, troublesome cough often persists for a day or two. For that reason the cavity should be opened at the first operation in such cases.

3. While steps must at times be taken to control distressing cough in patients already greatly weakened, under no conditions should narcotics be administered to the point of producing sleep so deep that the patient does not cough. Large quantities of pus must not be allowed to accumulate within the lung.

CASE 3. (A360675.) Mr. H., age 28, who registered in the Clinic June 7, 1921, had been ill for 11 weeks, during which time he had lost 40 pounds in weight. He had had hæmorrhages for about 2 weeks and was pale and emaciated.

Examination revealed an enormous abscess of the lung involving the upper right lobe (Fig. 13). The temperature was 103°. The leucocytes numbered 15,400. The pulse-rate varied from 112 to 120. There were signs of a large cavity in the upper lobe of the right lung with consolidation below.

The patient was put to bed in the open air; he was inclined to the right side, with ice-bags over the entire upper chest. He expectorated about 600 cubic centimeters of foul-smelling, reddish brown sputum a day. Forced feeding was instituted and he was given a glass of 5 per cent glucose solution to be taken over a period of 2 or 3 hours, and 120 grams of sodium bicarbonate in 24 hours. Hæmorrhage of about 500 cubic centimeters occurred on the third day after admission and on three other occasions in variable amounts within the next 10 days. After the second hæmorrhage an attempt was made to collapse the lung with oxygen, but the patient was so acutely ill that he could not be moved in order to have a roentgenogram made for the determination of the extent of collapse. His condition was so serious that transfusion was considered. His coagulation time of 9½ minutes was reduced to 3¼ minutes by the administration of calcium chlorid (10 cubic centimeters of a 10 per cent solution intravenously) on three occasions at intervals of from 5 to 6 days. The patient continued to spit up dark blood-stained sputum for 4 weeks. However, he did not have any further active hæmorrhage and gradually improved in health and was up and about by the middle of July. August 1 he was dismissed from our care entirely well (Fig. 14).

Three years earlier I would have considered this type of case urgently surgical. However, a patient with such an extensive abscess and so acutely ill belongs to the group in which the mortality rate following operation is high. Other cases similar to his have convinced me that well-controlled medical treatment should be tried out before an operation is undertaken. An interesting feature of this case is the development of a large pyogenic abscess without any demonstrable etiology.

CONCLUSIONS

1. Contrary to the opinion of the early writers that abscess of the lung is a common sequela of lobar pneumonia, a survey of the reported cases of the last century would lead us to conclude that it is a rare sequela.

2. By lowering the resistance in the lung tissue itself, the pneumonias (lobar, broncho, and influenzal) predispose the patient to the development of lung abscess following pyogenic infection.

3. Lung abscess occurs more often between the years of 25 and 40. It is three times as common in males as females; it occurs three times as often on the right side as on the left, and about twice as often in the lower lobe as in the upper. Three out of four are peripheral and involve the pleura, and one out of four is multiple.

4. It must be borne in mind that recently

a high percentage of lung abscesses has been the result of neglect or mismanagement on the part of the nose and throat surgeons, the oral surgeons, and the dentists. Such neglect or mismanagement is manifested in the selection of the anæsthetic, and in not keeping the patient's head low, and in not taking sufficient precautions to prevent the patient from inhaling foreign matter. Such a sequela may be avoided by (1) employing a local anæsthetic whenever possible in surgery of the mouth, nose, and throat, and in teeth extraction; (2) keeping the head low during such operations if a general anæsthetic is employed, until the patient has thoroughly aroused from it; (3) taking care to prevent blood and mucus from accumulating in the throat and being aspirated; and (4) better hæmostasis in such work.

5. The diagnosis depends on the history, the amount, and nature of the sputum, the roentgen-ray, and the physical examination.

6. A study of results in these cases has led me to conclude that surgery should not be employed as soon as the diagnosis has been made except as indicated. The mortality has been unnecessarily high in many instances. Instead, thorough medical treatment, with postural rest and drainage should be instituted. When this fails, pneumothorax should be produced in selected cases, and surgery reserved for those patients who do not respond to the other two methods.

7. The exploratory needle should not be employed.

8. When surgery is decided on, paravertebral and local anæsthesia, if necessary with gas and oxygen, should be used, and in the majority of cases a more deliberate, extensive, and logical operation should be planned than resection of the chest wall over the abscess, and cautery or blunt puncture of the abscess.

9. If the patient's condition is such that extensive operation would carry too much risk with it, resection, blunt puncture, and exploration of the abscess with the finger, should be the limit of surgery.

10. The surgeon, physician, and roentgenologist should be intimately associated in the diagnosis and care of these patients.

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MALIGNANT PAPILLOMA OF THE KIDNEY

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MALIGNANT papilloma of the kidney seems to be a very rare condition. The first case reported in this country was by A. O. J. Kelley (1), in 1900. Since that time there have been but 18 cases reported in America while the foreign literature contains a total of 38 cases. The American cases have been reported by Babcock (2), Watson and Cunningham (3), Lower (4), E. S. Judd (6), Hyman and Beer (5), C. H. Mayo (7), Stevens (8), and Goldstein (9), two cases by Kretschmer (10), three by Braasch (12), one each by Miller and Herbst (11), and McCown (13). There are two unreported cases by Burford (14), of St. Louis, and Parmenter (14), of Buffalo.

McCown in reporting his case made a very thorough study of the literature. He presents abstracts of 46 cases including the 38 foreign cases and his own. The total number of cases on record up to date is 56. To this number the writer adds below the fifty-seventh case. McCown's very thorough search of the literature and the report of his own case are to be found in the *Journal of the American Medical Association*.[1]

From an analysis of the cases thus far recorded the incidence of papillary epithelioma is more common in males than females in the proportion of two to one. Ages vary, the youngest being a young boy and the oldest a woman of 86. The etiology is unknown. Some authors are inclined to ascribe as the cause, inflammation, others stone. The tumors vary in size from multiple small, isolated, bud-like growths to a single, large, cauliflower mass filling the renal pelvis and producing as it grows destruction of the kidney parenchyma.

The tumor may start in the kidney and remain localized, but the striking tendency is to involve secondarily, either by direct extension or by implantation, the lower urinary tract. Of the cases reported, 25 showed involvement of the ureter while in 18 the tumor had invaded the kidney, ureter, and the bladder. The symptoms vary considerably with the size of the tumor and the associated pathology. Hæmaturia is the most constant sign. It is usually intermittent in character and may vary in severity from a slight cloudiness to a copious hæmorrhage. Pain is more or less inconstant but radiates from the kidney down the loin.

If the symptoms are not interrupted by surgical treatment, they may extend over quite a period of years. In the case reported by the writer, which was inoperable on account of the age and feebleness of the woman who was 82, the symptoms persisted for 6 years. Usually however, termination is seen relatively early. In adults especially, all cases showing intermittent hæmaturia and pain in the kidney region should suggest this condition. It is quite possible that some of the cases diagnosed as essential hæmaturia may be of this type when run down to their last analysis. Certainly this condition should be suspected if the roentgenograms are negative for stone, if there are colic-like attacks of pain radiating along the course of the ureters, if there is a diminished or absent function of the suspected kidney, and if there is a palpable mass in the loin. In addition to this, if cystoscopy reveals a papilloma of the bladder or the ureteral orifice, and the pyelogram reveals a filling defect in the pelvis of the kidney and the urine contains unidentified epithelial cells, the presence of a papillomatous tumor is well-nigh certain.

Judd regards the papillary structure as proliferating epithelium of the renal pelvis. The exact nature of the tumor seems to be based on the appearance of the epithelial cells within the connective tissue beneath the tumor. Papillary tumors of the pelvis of the kidney are usually, if not always, multiple. These neoplasms are divided by Judd into three classes: (1) the simple papillomata which show throughout their entire development and evolution the char-

[1] J. Am. M. Ass., 1920, lxxv, Oct. 30.

Specimen showing right kidney and ureter.

acteristics of all such tumors; (2) the epithelial papillomata which almost immediately show the characteristics of malignancy; and (3) those tumors which apparently change from a supposedly benign to a malignant growth. For practical purposes it would seem best to credit malignant tendencies to all of these papillomata and treat them in a radical manner.

From the standpoint of treatment, the cases of renal papilloma may be divided into two classes: those with and those without involvement of the bladder. In all cases nothing short of complete removal of the affected kidney and as much of the ureter as possible should be done. If there should be implantation in the bladder, fulguration may be done later. If, on the other hand, fulguration should be done on bladder papillomata and the trouble higher up in the ureter or the kidney is overlooked, it is easily seen that nothing is accomplished and that endless trouble may ensue.

The following case brings the total reported cases up to 57.

Mrs. C. K., age 82; the mother of six children; thin, anæmic, and feeble. She has never been robust but has suffered from invalidism more or less all her life. She has an old history of nephroptosis of the right kidney. About 4 years ago the writer was called, the condition was explained, and he was asked to push up the kidney in place as it had come down by reason of the journey from her home in Brooklyn to Atlantic City. She stated that for 2 or more years she had suffered from intermittent hæmaturia and that her Brooklyn physician relieved her discomfort when the kidney came down by replacing it. On attempting to carry out her wishes I discovered a mass in the right loin about the size of a large grape fruit apparently elongated at both ends. It was more or less movable and was pushed up to a higher level under the liver. The next day she began to bleed and this continued for ten days. My impression was that the mass was a hydronephroma.

The patient's heart, lungs, and circulation were normal, blood pressure 110–85. She was quite feeble and resisted suggestions of cystoscopy and X-rays to the end. She was under my observation most of the time for a period of four years. Bleeding would sometimes last for several weeks at a time and then cease. During the intermissions she would be able to be up and about the house. The last year of her life, however, was spent practically in bed. It seemed rather unusual that during the latter months of her life the attacks of bleeding were less frequent nor did they last so long when they did occur. During my observation of her case there were two or three distinct attacks of ureteral colic. One day she passed an unusually large amount of urine and on examination the mass in the loin had disappeared. It did not return. There is no doubt but that this mass was a hydronephroma.

From time to time there were attacks of gastric and intestinal trouble, and an occasional rise of temperature a degree or two. The patient gradually failed and died on November 8, 1921.

Autopsy: Only abdominal examination permitted. The stomach was normal, the gall bladder thickened and distended showing the presence of an old cholecystitis, but there were no stones in it. There were old adhesions about the pyloric end of the stomach, the duodenum, and gall bladder. There were no enlarged glands and no involvement of the intestines. The pelvic organs showed no gross pathology, but were atrophied. The left kidney and ureter were normal. The bladder was normal except for some small gravel-like concretions. There was no evidence of cystitis or of papillomatous implantations. The right kidney was but slightly larger than normal. The pelvis was overdistended and the ureter bluish in color and about four times its normal size. On splitting the kidney and ureter open, the pelvis of the kidney as well as the ureter were smooth and showed no gross lesions, but at the apex of many of the pyramids of Malpighi were found beautiful little tufted cauliflower masses. In the pelvis was an organized blood clot.

This kidney was submitted to Dr. John A. Kolmer, professor of pathology at the University of Pennsylvania, who has given the following

report: "The histological examination of the kidney shows the presence of a papilloma in the pelvis which has undergone malignant change. The correct designation should be epithelioma of the pelvis of the kidney. This growth is fairly well circumscribed with fibrous tissue, and for this reason gives a good prognosis on account of its slow growth. In general the kidney shows chronic interstitial and glomerular nephritis."

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PARABIOSIS AND ORGAN TRANSPLANTATION[1]

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THE problems concerned in tissue and organ transplantation have interested workers both in the laboratory and in the operating room. In the earlier period failures were encountered as a result of improper technique, lack of asepsis, etc., but all these factors have now been eliminated, and still there is the insurmountable obstacle presented by the absorption of the graft. As a matter of fact, where the technique is flawless and the asepsis beyond question, there have been successful autotransplants of entire organs (1); but, as soon as homotransplants were attempted, with the same skill and care, the result was almost invariably unsuccessful (2). Knauer reports successes in his ovarian transplants; heterotransplants have always failed to grow. These latter cases were characterized by the greater rapidity and intensity with which the graft was either absorbed or thrown off as a necrotic mass (3). All results so far lead to the conclusion that the graft acts as any foreign body does and meets with the same treatment from the host that any foreign invading body receives. The consensus of opinion is that chemicobiologic factors are responsible for these phenomena of lysis and absorption of the graft. Just what the differences are and how they can be rendered innocuous are the problems that confront investigators of this branch of surgery

Differences in the "chemistry" of individuals are not so marked in the lower animals as in the higher. In fact, in those animals characterized by biologists as low in the scale of evolution, homologous transplantation is almost invariably successful, and even heterologous (4) grafts are not unusual. In plant life, this fact is well illustrated by the seedless orange, a sport propagated wholly by grafting. These chemical differences can be greatly intensified by injecting tissue emulsions prior to the actual transplanting (5).

The extremely intimate connection between the two individuals of a parabiotic pair is very clearly shown by the work of those who have studied this subject. Morpurgo (6) succeeded in keeping alive a pair of rats for more than 40 days after he had performed a bilateral nephrectomy on one of them. In his series, the kidneys of the non-operated upon animal always showed a distinct compensatory enlargement. Sauerbruch and Heyde (7), showed that antibodies, agglutinins, etc., could be recovered in one animal after its partner had developed either active or passive immunity. In the case (8) of two sisters (who were born parabiotic) it was noted that when one became pregnant the breasts of the other were hypertrophied and filled with

[1]From Columbia University, Institute of Cancer Research, F. C. Wood, Director.

secretion. Jehn (9) by means of parabiosis prolonged the life of animals in which he had produced experimental uræmia. These instances are cited to show the extremely intimate relationship of the biological processes in the two individuals of a parabiotic pair.

The theory upon which the present study is based consists in the conception that a parabiotic union removes the chemico-biologic differences between two animals of the same species and makes the tissues of a graft taken from one of these animals bear the same chemico-biologic relation to the host as do the host's own tissues.

In these experiments, young adult rats of approximately the same age and weight were employed. The peritoneal cavity of one animal was opened by an incision made in the flank extending from the lowest rib to the pelvis. A similar incision was made in the other flank of a second animal. The two were then placed side by side so as to bring the incised surfaces adjacent to one another. These two stomata were closed, as are the stomata in the performance of a gastro-enterostomy. The peritoneum and muscle were sutured in one layer, the fascia and skin individually, thus making three layers. In only very few instances did these layers fail to hold. The most frequent fatal complications were intestinal obstruction, pneumonia, and undernutrition with starvation of one of the pair. A frequent minor complication was an infection of the skin, which, however, always healed without any untoward results.

Ten days after the parabiotic operation, the graft itself was transplanted. This interval allowed for complete healing and firm union of the first operative procedure. Half of one lobe of the thyroid gland was excised and inserted into a muscle pocket in the anterior abdominal wall of the other animal. This pocket was always prepared prior to the excision of the thyroid in order to reduce to a minimum any possible injury to the latter by drying or too much handling. This pocket was then closed in two layers, muscle and skin. Closure of the neck wound completed the operation. During this procedure the only complication that occurred was troublesome bleeding from the severed thyroid arteries, which now and then resulted fatally.

Forty-four pairs of animals were employed in the experiments. Of these, 3 pairs died before transplantation of the thyroid tissue, 5 pairs were lost, and 7 pairs were decomposed to an extent that made histological findings worthless. This left 32 pairs for study. Of this number, 12 showed absolutely no trace of the implanted tissue.

In order to have a standard of comparison, two series of autografts and homografts were made, and sections of the thyroids from the parabiotic animals were studied parallel with these. With the exception of the graft in rat No. 17982, all the grafts showed marked lymphocytic infiltration, with very little apparently healthy thyroid substance remaining. In other words, the foreign body reaction and the lytic processes on the part of the host were more marked even than those in the homograft, and very much more than those in the autograft. The parabiosis did not, therefore, neutralize the chemico-biologic differences; if anything it seemed to make them more intense. The exception noted above may have been the result of mere coincidence, that is, of similar or almost similar blood chemistry in the two rats.

CONCLUSIONS

Parabiosis does not inhibit those unknown agencies which, in so many instances, interfere with the success of homografts of highly developed organs, such as the thyroid.

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UTERUS DUPLEX BICORNIS

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IN reviewing the literature on the subject of uterus bicornis, we find it frequently stated that this condition is a common occurrence. Relatively only a small number have been reported. Rockey (1) reports that the index of the first sixty volumes of the *Annals of Surgery* make no mention of this condition. In Ashurst's *Surgery*, written about 40 years ago, Parlin, of Philadelphia, quotes 8 cases from the literature. Kelly's textbook on *Operative Gynecology*, published in 1898, gives an illustration of a case. Another case is reported by Fisher in volume V of Keen's *Surgery*. In the few textbooks and encyclopedias mentioning the condition, we usually find the description limited to a few lines.

The first case of pregnancy in the rudimentary horn of a uterus bicornis dates back of 1669, and was recorded by Mauriceau and Vassal. DeLee (2), in 1916, reported a collection of about one hundred cases of pregnancy in a rudimentary horn of a uterus bicornis. In reviewing the literature further, we find several cases reported since that date. One of the most interesting cases on record is reported by Scott and Forman (3), in which twin pregnancy existed in a horn of a bicornuate uterus, for 20 years. In this case they report three full-term pregnancies and three miscarriages which occurred during the period of pregnancy that existed in one horn. The pregnancy which lasted for 20 years was terminated by operation, at which time two lithopedians were removed. It is interesting to note in their report that this patient showed normal menstruation when the 20 years' pregnancy first occurred. Jackson (4) reports a case of bicornuate uterus, with pregnancy, which was operated upon for intestinal obstruction. Mention is made by Cornell and Earle (5) of a uterus bicornis unicollis with two ova implanted in one horn. This was diagnosed ruptured ectopic with fibroid. Broadhead (6) describes a case of pregnancy in the rudimentary horn of a bicornuate uterus; gestation occurred four times in the right horn and the fifth time the left horn was involved. Watkins (7) reported a case of uterus bicornis which came to operation because of a strangulated ovarian cyst.

There are many interesting factors in the subject of malformations of uterus. The literature enlightens us by showing that there are probably many such conditions that are never diagnosed. This is shown by the fact that operation often reveals anomalies that are not suspected. Reports show that cases have been diagnosed as ovarian cysts, occasionally as uterine myomata, or even as ectopic pregnancy. In a case of uterus duplex bicornis, it is not difficult to make a diagnosis because the two openings in the cervix can be seen and frequently felt while making a bimanual examination.

It is of interest to note that in a great many cases of uterus bicornis that have been reported, there was a twin pregnancy in one horn. Probably there is a biological factor which may have an influence in causing this frequency of twin pregnancies in a double uterus. However, the anatomical structure and the physiological function are without a doubt a factor. In only a few cases reported, the pregnancy occurred in both sides, and only one case was found where pregnancy existed in both horns at the same time. No twin pregnancies were reported in both horns at the same time.

Unfortunately the history of menstrual function has been overlooked in many of the reports. In Case 1 of our series, menstruation occurred each month during the gravid period of her first pregnancy. In such cases it is difficult to figure the time of conception. It was a mystery why monthly menstruation was present until the malformation of the uterus was discovered. We would conclude that the function and the anatomy of this uterus must have been more or less equally developed in both horns.

The classification of malformations of the uterus varies in nomenclature. In many of the cases reported one could not decide in what category the specimen belonged, no statement being made of a duplex or a single cavity in the cervix. Our cases were of the duplex bicornis type, there being two distinct cavities, each communicating with the vagina by an os. One case presented a perforation of the septum just above the openings into the cervix. In this connection we might make mention of a case which is very singular, however. Wardlow had a case some years ago where there was a uterus duplex bicornis discovered at the time of delivery, at term. It was a breech presentation with a prolonged second stage. Both lower extremities delivered, but there the progress stopped. After this condition remained for some time without progress, careful examination revealed a perforation in the septum with one limb through this opening, and the babe staying in this position on account of the unusual anomaly. The septum which formed the saddle for the babe was cut with scissors and spontaneous delivery occurred. A case was operated upon by Wardlow at the university clinic, which showed a uterus duplex bicornis. Thus four cases have come under our observation.

In malformations of the pelvic organs it does not always follow that symptoms must be present, interfering with the health of the individual. Yet, we know that when developmental anomalies exist there is a predisposition to infection and disease. This is frequently found in organs like the kidneys. Definite symptoms can be charged to congenital malformations of the uterus in some cases but they do not necessarily call for operative treatment. A septum in the uterus can be removed by one of the several methods mentioned by authors. This is not always necessary since the organ will perform its intended function to the degree desired.

Operative procedure is required when sufficient symptoms exist to cause the patient to suffer discomfort or where infections complicate the field. One does not desire to produce an artificial menopause in young women but certain cases require that this be done because the lesion is interfering with the economy of the individual. When hysterectomy is considered advisable, let us not forget that the ureters may be displaced and injury to them may result unless this fact is kept in mind. Upon opening the abdomen, one might be puzzled when he finds the rectovesical ligament, unless he is familiar with this structure; it was marked in one of our cases, forming two distinct pelvic cavities. The attachment extended from the fundus of the bladder to the rectosigmoid junction. In performing a hysterectomy, careful dissection is required, thus avoiding injury to the bladder, rectum, and ureters. The fascia is well formed in this ligament and one hesitates at first to sever the structure, fearing it might contain a diverticulum of the bladder, or an extension of the rectum.

It is well to know in cases of pregnancy if we are dealing with an abnormal uterus. Frequently in the duplex bicornis type or in a unicornuate uterus the musculature lacks the proper development, and the natural forces in delivery are unable to play their part. Thus a prolonged labor may result from lack of expulsive power. Also under such conditions the wall may be thin, and there is danger of rupture. Such cases may require cæsarean operation.

The development of anomalies of the uterus is frequently found in individuals that show other developmental changes. Schwarz (9) says: "Most cases of uterus bicornis show an abnormally broad pelvis, which would account for the failure of the muellerian ducts to fuse into normal adult shape." In our cases both women are tall and larger than the average female. Our pelvic measurements confirm the view of Schwarz, as both cases have increased pelvic diameters.

CASE 1. Referred by Dr. Wyker, July 16, 1921. Mrs. W., age 35. When a girl she was large for her age but not strong. Menstruation began at 13 years of age, coming at 4 to 6 week periods. This irregularity has continued to the present time. She flowed 7 days, using 4 to 6 napkins. Last 2 years' flow lasted 4 days. Leucorrhœa since a child. With each period there is swelling of mammæ with soreness. Dysmenorrhœa has been present for about 2 years. Patient has bearing-down feeling in pelvis, and crampy pains in both ovarian regions lasting

Fig. 1. Case 1. Uterus duplex bicornis, showing the cornua with tubes attached. Septum is shown between the two openings in cervix.

Fig. 2. Case 2. Uterus duplex bicornis, showing incisions into two distinct cavities.

through period. The pain and distress has been almost unbearable recently. As far as patient knows, she has never been pregnant. In the spring of 1921, two periods were missed, cause not known. The sexual function is somewhat abnormal, in that there is no excitement during coitus. A dyspareunic hymen causes some discomfort in this case.

Recently this patient has become very nervous and feels exhausted. For about 1 year, there has been vesical irritation with polyuria.

Physical examination was negative, except for pelvis. The uterus is retroverted. There is an anteroposterior septum in upper part of vagina, and on each side of this is a distinct os into the cervix. Further palpation shows the uterus to be divided, forming two distinct horns (uterus bicornis).

Laboratory notes. Blood count: reds, 4,600,000; white, 9,000; polymorphonuclears, 51 per cent; small lymphocytes, 36 per cent; large lymphocytes, 9 per cent; and mononuclear, 4 per cent. Urinary examination, negative.

Operation. Excision of dyspareunic band. Dilatation of each uterine cavity and packed with iodine gauze. Both ovaries resected. Pan-hysterectomy with a double salpingectomy was performed.

Case 2. Referred by Dr. Neiswander, June 6, 1920. Mrs. S., age, 30 years. Patient was a well-developed and healthy individual, until recent trouble occurred. Menstruation began at the age of 15 years, was regular 28-day type, flow from 7 to 10 days, copious, no pain. Patient has one child, 2 years of age. Delivery and puerperium were normal. During this gravid period patient menstruated regularly each month. The reason for this was puzzling at that time.

In February, 1920, patient had influenza, which confined her to bed for about 2 weeks. During this illness she had a very profuse menstruation, normal time. In March, period was normal. During April and May she had occasional bleeding from the uterus but not a regular menstrual period. June 5 the discharge was marked. On June 10, 1920, patient had a chill and temperature of 100°, pulse 118. This was accompanied with cramp-like, intermittent pains in middle of lower abdomen and pelvis. The bloody discharge was profuse.

Blood count: red, normal; white, 18,000; polymorphonuclears, 90 per cent. Urine, negative. A diagnosis of inevitable abortion was made. Pelvic examination revealed a uterus duplex bicornis, two distinct openings into the cervix with a perforation of the septum, large enough to admit the finger, ¾ inch above the external os. The two cornua were readily palpated. The cervix was dilated and from the right horn two fœtus were removed, both of which were 15 centimeters in length, and each one was attached to a separate placenta.

Patient came to hospital again March 21, 1921. At this time an operation was performed for salpingitis. A pan-hysterectomy and a double salpingectomy were performed. A cyst 6 centimeters in diameter was removed from the left ovary. The rectovesical ligament was well developed, thus forming two distinct pelvic cavities.

DEVELOPMENT

The muellerian ducts develop as epithelial thickenings near the anterior ends of the mesonephros. Later a groove appears, ventro-

lateral in the epithelium of the mesonephric fold. The lips of this groove close and form a tube. Cranially the tube remains open, thus forming the ostium-abdominale of the muellerian duct. The tube grows caudalward and eventually the duct opens into the urogenital sinus. In 20 to 30 millimeter embryos their caudal ends extend as far as the muellerian tubercle, a projection into the dorsomedian wall of the vesico-urethral anlage. The muellerian tubercle marks the position of the future hymen. Following this there is a fusion of the muellerian ducts, caudally, giving rise to the unpaired anlage of the uterus and vagina. The septum between the two lumina disappears usually during the sixteenth week. The muellerian ducts make two bends as they develop in the urogenital folds, their course corresponding to these folds. They consist of cranial and caudal longitudinal portions and a middle transverse portion. The caudal longitudinal portion is fused with its fellow to form the uterovaginal anlage.

The mesenchyma above the uterovaginal anlage differentiates into muscle and connective tissue of the uterus and the vagina. The wall between the transverse portions of the muellerian ducts bulges outward so that the cranial concavity is now convex. The transverse portions of the ducts form the fundus of the uterus and the vagina, developing from the uterovaginal anlage. The growth of the uterus is slow. It is practically the same length at birth as in a girl at 9 years. At the time of puberty, growth is more rapid, reaching a length of 72 millimeters at 18 years, nearly the maximum of the virgin uterus.

Failure of union of the muellerian ducts results in the different malformations. In the opossum we find the uterus duplex bicornis, cum vagina duplici. In the squirrel and beaver, we find normally a uterus duplex bicornis. In the dog, hyena and sheep, there is a uterus bicornis unicollis. The ant-eater presents a uterus biforis, while in the birds there seems to be a unilateral development, forming a uterus unicornis. Various forms may develop as a result of an unequal development in the two sides. When both halves develop equally, menstruation and conception in both sides are possible. Pregnancy usually occurs in the better developed side. It is difficult to explain the various anomalies occurring in the derivatives in the muellerian ducts. In the normal mustelus antarcticus the uterus is divided into compartments. In oviparius monatremes the muellerian ducts do not fuse but remain distinct and open into the urogenital canals. We can trace the differentiation of the oviducts in the opossum. A dilated portion of each oviduct gives rise to a uterus. Each uterus communicates with the vagina by a distinct os. The uterus bicornis is found in carnivores and most ungulates, and the uterus simplex in primates.

SUMMARY

1. Malformations of the uterus are not uncommon, but relatively few in number are recognized.

2. Pregnancy may occur in both horns of a uterus bicornis.

3. Menstruation may occur during pregnancy in a bicornuate uterus.

4. Statistics show frequent occurrence of twin pregnancy in this type of uterus.

5. Malformations of the pelvis may or may not exist with anomalies of the uterus.

6. Reports of uterine malformations should give complete history of menstrual function.

7. Malformations of the uterus are frequently confused in diagnosing pelvic and abdominal lesions.

8. When doing a hysterectomy in malformations of the uterus, always be careful to avoid injury of a misplaced ureter.

9. The rectovesical ligament is confusing when first encountered.

10. Cases in this report are classified as given by Graves (*Gynecology*).

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DEPARTMENT OF TECHNIQUE

THE STRAIGHT VESSELS OF THE TERMINAL ILEUM[1]

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IT is my desire to call attention to the straight vessels of the terminal ileum as a hitherto undescribed, though definite, anatomical feature of this portion of the intestinal tube. Its value lies in the ability of the surgeon to recognize at a glance this particular and important part of the intestinal tube, namely, the last inch and one-half of the terminal ileum, by recognizing

Fig. 1. Sketch from living specimen showing three straight vessels in last inch and one-half of ileum, running parallel with the long axis of small bowel. Sometimes only one or two vessels are found present.

[1] Presented before the Southern Surgical Association at Pinehurst, December 14, 1921.

Fig. 2. A right rectus incision. A quick location of ileocæcal valve or appendix is made easy by picking up the terminal ileum which is recognized by the longitudinal vessels as seen on the lowermost knuckle of bowel presenting in the incision.

the straight vessels found only at this point in the whole of the intestinal canal as a definite and distinguishing feature.

From the pylorus downward in the small bowel to a point approximately one and one half inches from the ileocæcal valve, the visible vessels run at right angles to the long axis of the bowel passing up from the mesentery on each side of the convex surface to meet over the point opposite the mesentery. In the last inch and one half of the terminal ileum, there are, however, one, two, or three small straight vessels which come up from the anastomosis formed by the ileocolic and the right colic arteries, sending these branches upward from the ileocæcal valve just under the peritoneum and parallel to the long axis of the bowel for a distance of one-half to one and one-half inches or thereabout. These straight vessels, as shown in the accompanying illustrations, are definite end arteries and run immediately beneath the peritoneal coat of the bowel, whereas, the other blood vessels supplying the small bowel run between the mucosa and submucosa.

With regard to frequency of this finding, we have observed these vessels to be present, and they have definitely indicated to us this particular point of the small bowel, in one thousand successive laparotomies.

While there are many reasons for locating without difficulty the ileocæcal valve, the greatest use for this definite anatomical point is probably to be found in locating the appendix, using the last inch and one-half of the terminal ileum as a more definite and more ready guide to the base of the appendix than other methods of location such as following the longitudinal muscle bands of the large bowel.

CHOLECYSTECTOMY FOR CHOLELITHIASIS

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THOUGH much has been done toward obviating unpleasant results and recurrences after operations upon the biliary tract and some progress has been made, we must still conclude that in the aggregate the results are not satisfactory. A considerable number of patients complain of symptoms referable to the upper abdomen after operation and a certain number of these require secondary operations for relief. The percentage varies with the individual operator but in all thus far reported is fairly large. The recurrences in the hands of the average surgeon are probably of greater number than those reported from the large clinics as he is not in a position to select his cases and as a rule does not operate upon his patients until the disease is well advanced and the pathology present greater in amount.

The causes given for the necessity for re-operation are mainly adhesions forming after operation and stones in the ducts either overlooked at the time of the primary operation or subsequently formed. Occasionally the hepatic or common ducts are injured at the primary operation and the subsequent operation is necessary to do away with the resulting obstruction of the biliary passages causing jaundice with its train of disagreeable symptoms. With this class of unpleasant results discarded there remains still a fairly large percentage of cases in which the result is not satisfactory. No definite point can be found but the patients are not up to par and complain of indefinite gastric and abdominal symptoms. There is no sufficient indication for another operation but the patients are not cured and the result must be classed as unsatisfactory with no relief promised by further surgical interference. This is the most difficult type of case to manage and care for. The patients have been relieved of the mechanical condition from which they suffered and all symptoms referable to that mechanical difficulty have disappeared but in their stead is left a complex of indefinite symptoms for which a definite removable cause cannot be located. This condition of affairs has justly given rise to considerable skepticism both among the laity and the medical profession as to the ultimate value of surgery upon the biliary tract. The result is that the operation is postponed as long as possible and cases do not reach the surgeon until they are far advanced and operative cure is rendered more difficult.

These indefinite disturbances in the physiology of the upper part of the gastro-intestinal tract are due to some interruption of the nervous mechanism by which the various integral parts of the complex are correlated in their action. In order that gastric and upper intestinal digestion may proceed in a normal manner, there must be a harmonious and governed action of the stomach, liver, duodenum, and pancreas. Lack of proper action of any one of these organs with relation to the others will disturb the proper functioning of the upper intestinal tract.

Embryologically the point of origin of the biliary tract is situated in the most complex part of the human economy and the liver is one of the most important organs of intra-uterine as well as extra-uterine life. The gall bladder develops from a bud of the fore gut, the original site of which remains as the papilla of Vater situated in the second portion of the duodenum. This hepatic anlage develops in the folds of the ventral mesogastrium, being connected behind, with the gut by the biliary tract, representing the original stalk of the hepatic bud; with the arterial system by the hepatic artery and with the venous plexus of the gut by the omphalomesenteric vein which subsequently forms the portal vein (Fig. 1). Early in embryonal life the umbilical vein leaves its position as a body wall vein and shifts to its intra-abdominal position passing along and defining the lower border of the ventral mesogastrium finally to enter the liver at the transverse fissure and break up into its radicals. Accompanying the structures as they pass through the mesogastrium into the liver are the branches of the sympathetic nervous system and the lymphatics emerge from the liver at the same point. The function of the sympathetic nervous system in this location is to form the connecting link between the various organs which develop from this part of the gastro-intestinal tract and assume different positions as development proceeds. There is also a connection between the hepatic plexus of the sympathetic and the left vagus nerve which traces a direct connection between that plexus and both the superficial and deep cardiac plexus by which a pathway is established for impulses which co-ordinate cardiac action with that of

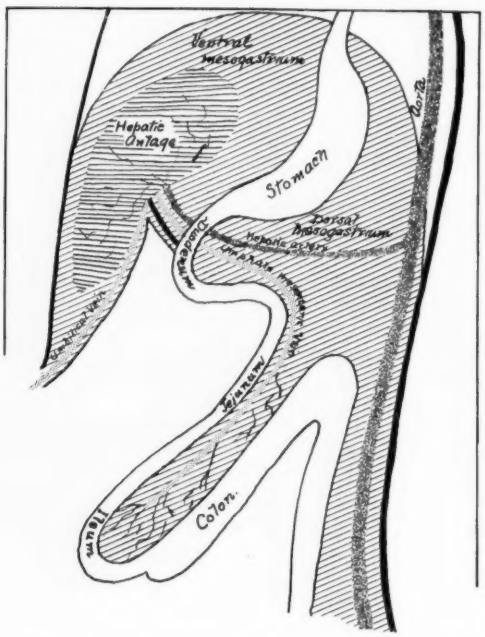

Fig. 1. Lateral schematic view of early stage of development showing the various connections of the developing liver and biliary systems. Branches of the sympathetic nervous system accompany all the blood vessels.

digestion in adult life. It can be seen what an extremely important part of the human economy physiologically this inferior border of the ventral mesogastrium represents in both intra-uterine and adult life.

With the positional changes which occur in development, that portion of the ventral mesogastrium between liver above and in front, and pyloric end of stomach below and behind, assumes a transverse position and lies in a vertical plane constituting the right portion of the gastrohepatic omentum. Its right border limits the anterior margin of the foramen of Winslow and between its leaves lie the hepatic and cystic ducts with the beginning of the common bile duct, the hepatic artery with its cystic branches, the portal vein, the hepatic plexus of the sympathetic nervous system, and the largest of the lymphatics draining the liver. The fibers of the hepatic plexus parallel and partly surround the cystic and hepatic ducts, and a complete division of the gastrohepatic omentum at this point severs the nerve connection between a portion of the liver above and the pyloric end of the stomach, upper duodenum, and pancreas below. The importance of these structures, especially the sympathetic plexus, in the proper regulation and co-ordination of hepatic function with the function of the other organs cannot easily be overestimated, and it is this part of the body that the surgeon must attack in his operative procedure in order to reach the lower portion of the gall bladder and the biliary ducts.

From the above considerations it would appear that a properly performed cholecystectomy is an operation of extreme delicacy calling for minute and careful dissection to free the cystic duct and arteries from the surrounding structures before ligating and dividing them. The operation as usually performed, drawing the gall bladder upward and dislocating the liver, locating the cystic duct and placing a clamp on it, including in the clamped structures the gastrohepatic omentum, is a dangerous procedure for in this manipulation those branches of the hepatic plexus which accompany the cystic duct and cystic arteries are bound to be divided and the chances are that many of the branches to the right lobe of the liver will likewise be divided. Those branches which pass downward along the superior pancreaticoduodenal artery are also in danger and if these are divided the connection between the liver and pancreas through the sympathetic system is broken. With this broken the co-ordination between stomach, duodenum, pancreas, and liver is impaired, and there results an independent action of the liver cells uncontrolled by the stimuli which normally reach them from the other organs. The consequence of this is a disturbance in the physiology of the upper part of the digestive tract which gives rise to the vague and indefinite symptoms complained of by the patient. An operation of this character relieves the patient of the mechanical difficulty but because of the injury to the sympathetic system has caused a disturbance of the physiology of the upper part of the digestive tract which is irreparable and gives rise to unpleasant symptoms.

These symptoms can be avoided by a carefully done cholecystectomy which may be performed either from the fundus of the gall bladder toward the cystic duct or in the opposite direction. If the gall bladder is distended it is usually a simpler technical procedure to start the removal at the fundus. If, on the other hand, the gall bladder is small and contracted the gastrohepatic omentum can first be opened and the cystic duct and arteries dissected free from surrounding structures before they are divided. In either case the peritoneum covering the gall bladder should

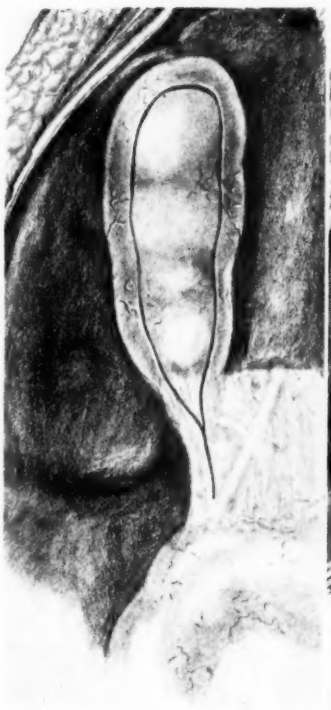

Fig. 2.

Fig. 3.

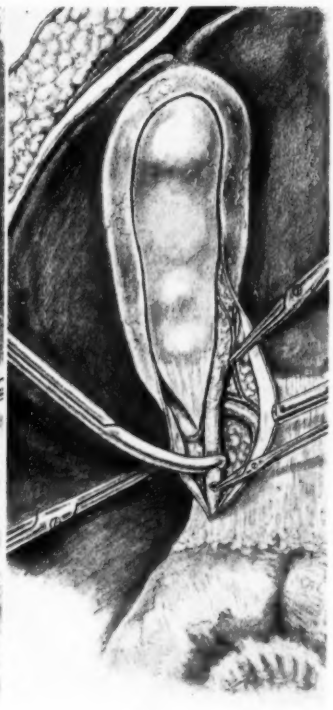

Fig. 4.

Fig. 2. Incision through peritoneum covering gall bladder continued down through anterior leaf of gastrohepatic omentum.

Fig. 3. Cystic and right hepatic ducts defined. Cystic artery located.

Fig. 4. Removal from below. Cystic duct clamped below stones. Cystic artery clamped. Cystic duct opened below clamp and edge held with forceps at site of future division preparatory to exploration of common and hepatic ducts.

be incised along the lateral aspects of the organ in such a manner as to leave a cuff on either side, the raw edges of which can subsequently be sutured together covering the raw surface left after the removal of the gall bladder (Fig. 2). By this technique the gall bladder is removed from its attachment to the liver along the original line of cleavage between the two structures and the surface of the liver is not torn. Consequently there is but little hæmorrhage from liver surface. Careful dissection of the biliary duct system in the gastrohepatic omentum obviates the danger of injury to the ducts, either of including the hepatic or common duct in the clamp and ligating them or partial division of the common or hepatic ducts. If the typical arrangement of the junction of cystic and hepatic ducts in which the hepatic duct joins the cystic duct at an acute angle forming the triangle of Calot were the rule, this would not be so important. Ruge states, however, that this arrangement obtains in only about 33⅓ per cent of cases and his results have been substantiated by other observers. Seelig (1) has already pointed out the importance of the recognition of the variations in the ducts and advocates removal of the gall bladder from above downward in order to minimize the danger of injuring the ducts. Eisendrath (2) has given a detailed study of the arrangement of the biliary ducts which fully confirms the observations of Ruge and the earlier observers. In the technique here described the cystic duct, being dissected out, is clearly defined and the danger of injury to the hepatic and common ducts is practically done away with. Before clamping the cystic duct it should be cleared all the way down to its junction with the hepatic duct and carefully examined for stones lodged in its distal

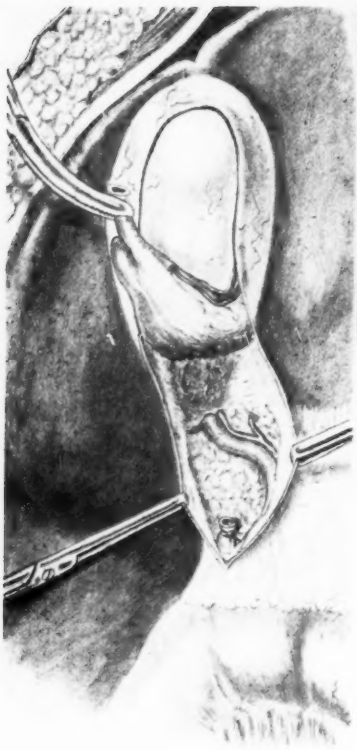

Fig. 5.

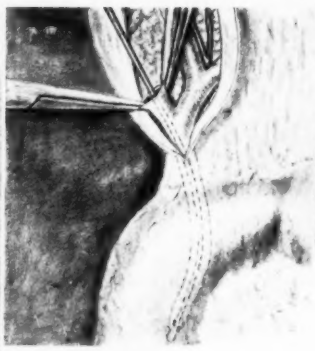

Fig. 7.

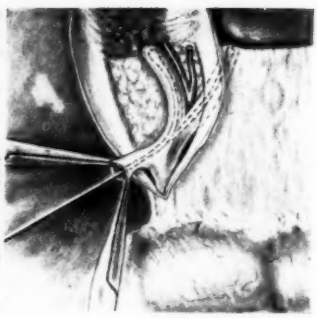

Fig. 8.

Fig. 5. Removal from below upward. The cystic duct is shown ligated but this is not done until after the ducts have been explored (see Figs. 7 and 8).
Fig. 7. Probing common duct (after Seelig).
Fig. 8. Probing hepatic duct (after Seelig).

portion. Owing to the slight constriction caused by the junction with the common hepatic duct stones in the duct are often arrested at this point. It is well to bear in mind that cases in which there is a history of biliary colic nearly always show calculi in the cystic duct. Calculi in the gall bladder itself do not cause colic and may and often do remain quiescent for years and give no symptoms. Therefore if biliary colic is a symptom it is fairly certain there will be calculi in the cystic duct. These may be very small, if of the mulberry variety, and extremely difficult to palpate. In a recent case it was not possible to palpate any calculi until the duct had been carefully isolated, when three small mulberry stones were found in the cystic duct, the largest of which was 3 millimeters in diameter and the smallest 2 millimeters. The distal stone being located, it is frequently possible by gentle manipulation to move it up a sufficient distance to apply the clamp below it as shown in Figure 4. After division of the cystic duct the gall bladder is removed from below upward (Fig. 5).

In removal from above downward (Fig. 6) it is well to make a preliminary examination of the ducts in the gastrohepatic omentum. In many instances complete dissection is impossible and it is in such cases that removal from above downward is indicated and the dissection of the ducts is completed after the gall bladder has been mobilized. The subsequent steps of the procedure are the same in either method of removal. By carefully dissecting the peritoneum from the mesial side of the gall bladder as the dissection proceeds downward from the fundus the cystic artery can be isolated, clamped, and divided with little, if any, hæmorrhage, and hæmorrhage more than anything else makes an accurate dissection of the ducts difficult.

After the removal of the gall bladder the remaining portion of the cystic duct, the common duct and the hepatic ducts must be carefully explored for stones (Figs. 7 and 8). This is done both by probing either with a probe or in the case of dilated ducts with the finger or by placing the finger in the foramen of Winslow to the right of the hepatic artery and palpating the common duct as it passes between pancreas and duodenum to its orifice in the latter. This is not a difficult procedure when the probe is in place in the duct. If stones are found they are removed either by direct or transduodenal choledochotomy.

The treatment of the stump of the cystic duct and whether or not to drain the site of operation

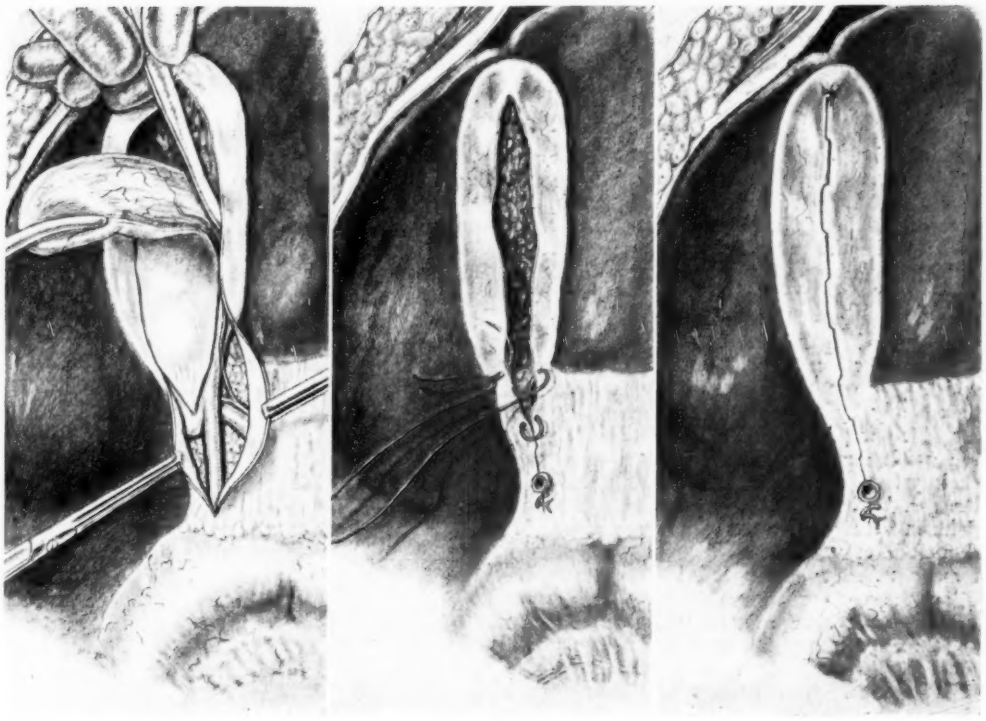

Fig. 6. Fig. 9. Fig. 10.

Fig. 6. Removal from above downward. Cystic artery is being approached preliminary to ligation.

Fig. 9. The cystic duct has been ligated and anchored in the sutured incision in the gastrohepatic omentum in such a way that it maintains the proper angle with the hepatic duct.

Fig. 10. Operation completed. Peritoneal cuffs sutured to cover raw surface of the liver.

is a difficult one to decide and the surgeon must make this decision at the time of the operation. Although no rule of thumb can be laid down it may be stated that the determining factor is the condition of the biliary ducts, hepatic, cystic and common. If there is present a condition of the ducts which will give rise to a mechanical blocking of the lumen, drainage is necessary until such a time as the patency of the lumen is re-established. The blockage is usually temporary and disappears in a comparatively short time. As a rule it is due to an inflammatory swelling or œdema of the lining epithelium caused either by infective cholangeitis or trauma incident to the presence of stones. The mechanical block due to stones themselves may be disregarded as all stones should be removed at operation. That due to injury of ducts may also be disregarded as with an operation performed as noted above the ducts are clearly exposed and anomalies recognized and dealt with accordingly. The trauma incident to the removal of stones from the hepatic or common ducts will practically always be followed by an œdema of the lining epithelium of the ducts sufficient to cause a temporary block to the passage of bile. It is, therefore, the practice of the writer, in all cases in which no stones are encountered in the common or hepatic ducts or in which there is no marked inflammation of the mucosa of the ducts, to close the cystic duct by ligature, cauterize the stump, and religate with a heavy catgut ligature placed just beyond the first ligature nearer the beginning of the common duct. The ends of this ligature are left long and their use will be described later. If there are stones present it may be assumed that the trauma incident to their removal is sufficient to cause an œdema of the

mucosa which will give rise to a temporary mechanical obstacle to the passage of bile through the duct to the gut. In such cases both hepatic and common ducts should be drained. Drainage of the common duct through the stump of the cystic duct is sufficient in the presence of a cholangeitis not due to stones.

The question of the behavior of the short stump of the cystic duct when involved in the scar of healing seems an important one. If left free with the gastrohepatic omentum divided as in the usual operation, it may assume almost any position and cause an anomaly of its normal type of junction with the hepatic duct. Stetten (3) described an angulation of the junction of the hepatic and common ducts after cholecystostomy which gave rise to symptoms that could be relieved only by a secondary operation. It is a far different procedure to locate the stump of the cystic duct at a secondary operation after cholecystectomy than after cholecystostomy, for the gall bladder is no longer present to act as a guide in the dissection and in fact proper recognition of the exact relation of the ducts is well-nigh impossible. The cystic duct is immobilized by using the ends of the second ligating suture spoken of previously. After tying this the ends are threaded into needles and pulled upon until the duct stump assumes its proper relation to the hepatic duct. The needles are then passed through the edges of the incision in the gastrohepatic omentum and the stump of the duct anchored in place by tying the sutures (Fig. 9). That part of the stump beyond the ligature is free and uncovered so if any leakage takes place it will follow the line of least resistance to the abdominal wound along the line of the intraperitoneal drain. While if it disappears, as is usual in the process of healing, it leaves the stump of the cystic duct anchored in its normal position within the gastrohepatic omentum and adherent to the inner surface of the peritoneum of that omentum so that even though the gall bladder, which in the normal keeps it in place, is gone it still has a point of fixation and cannot assume an abnormal position and give rise to an anomaly of the duct relations or an angulation of the ducts. The gastrohepatic omentum being closed about and above it and the peritoneal cuffs from the gall bladder being sutured, a smooth peritonealized surface is left which reduces the danger of postoperative adhesions to a minimum (Fig. 10).

Though the ducts themselves are not drained it is erring on the side of safety to place a small cigarette drain down to the stump of the cystic duct which can be removed at the end of 24 to 36 hours. Should the stump of the duct break open the bile will flow along the tract thus formed and appear at the abdominal wound rather than escape into the peritoneal cavity. Thus far this has not occurred, but as a measure of safety I use the intraperitoneal drain and have not as yet had the courage to close the abdominal wall without this temporary drainage.

CONCLUSION

The functions of stomach, duodenum, and pancreas are very closely connected by the sympathetic nervous system. A break in this system made by an operation will cause a lack of co-ordination in the interaction of these various viscera which will give rise to disturbed digestion with resulting symptoms. This disturbance can be avoided by carefully performed intraperitoneal dissection of the biliary system with as little trauma and destruction of tissue as possible.

In order that after operation the bile may have a free passage from the liver to the intestine, it is important that the normal relation between the stump of the cystic duct and the hepatic ducts be maintained. This can be done by anchoring the stump of the cystic duct in the incision made in the anterior leaf of the gastrohepatic omentum.

Postoperative adhesions can be minimized by forming cuffs of the peritoneum covering the gall bladder and after removal of the gall bladder, suturing the cut edges of these cuffs.

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THE COMBINED TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR

By E. L. ELIASON, A.B., M.D., F.A.C.S., Philadelphia

IN 1918, the writer published an article[1] on the external fixation in fractures of the femoral shaft. Briefly, it is the fixation of the patient in a plaster casing with the limb in the flexed position. The casing is attached to a modified Bradford frame and the traction is likewise intact with the frame (Fig. 1).

Given a case of fracture of the shaft of the femur, what is the best means of handling it? The earliest possible application of traction is important. This should be applied with weights and fixation splints; Hodgen, Thomas (angled) or posterior angled splint. The traction must be in the line of the long axis of the broken bone and applied through adhesive or through direct bone attachment with the tongs, calipers, or pins.

The primary reduction under anæsthetic and the fixation in the flat position, gives poor results with shortening in practically every adult case; 100 per cent failures in a series of 88 cases recently reported. The flexed position without traction, in the same series, gave 25 per cent good results; operative treatment and dressings in the flat position without traction gave 33⅓ per cent good results.

With the limb fixed or under traction, sufficient to reduce the shortening, an X-ray is taken at the earliest possible moment. If the two views show good alignment and but little shortening, increase the traction, using tongs or pins, if the adhesive is not practical. Another X-ray is taken 24 hours later and if the fragments have the slightest amount of end-to-end approximation, the treatment is continued. It is absolutely imperative that the thigh and leg be flexed from 45 per cent to 60 per cent for it is only in this position that the muscles affecting the femur are in a state of "equilibrium."

In fractures of the upper half it is well to abduct the limb as well as internally rotate the lower fragment in order more nearly to meet the position of the upper fragment. At all times the strictest attention must be paid to the traction. It must work uniformly. A fish scales placed in the rope between the limb and the pulley will always indicate the efficiency and the amount of the traction (Fig. 1).

[1]Eliason. Method of external fixation for fracture of femur. Surg., Gynec. & Obst., 1918, xxvii, 443.

It has been the writer's experience that unless the fragments engage somewhat, it is best to do an open reduction and fixation. Of course, in many instances good results are obtained, 56 per cent in the above quoted series, without an operation, but it is rather a trying and hazardous method as it really requires especially trained nurses, orderlies, and assistants. (Figs. 16 and 21 illustrate results under such treatment.) If then, with the above treatment tried for 4 or 5 days, we cannot reduce the fracture or, obtaining reduction, we cannot maintain it, then it is our duty to advise operation, for in the above quoted series the closed treatment gave but 56 per cent good results. The success of the operative treatment depends, however, upon technique and postoperative care. In other words, we must prevent infection, make a stable union, without too much trauma, and lastly maintain this internal splinting in a position of muscle equilibrium.

Prevention of infection. Most infections are of the staphylococcic type and probably are a result of skin contamination. To prevent this, use a scrub-up preparation the evening before operation and apply a sterile dry dressing. On the operating table (Hawley) use iodine and alcohol.

At this point the decision is to be made as to the type traction you will use for reduction and for postoperative treatment. If bone traction by the tongs or Steinmann nails is to be used, it should be placed now and attached to whatever is to be used as the tractor. The writer has devised an addition to the Hawley table which he has found very satisfactory. In the absence of this a stout loop of bandage can be passed through the tongs or Steinmann irons and around the shoulders of an assistant or orderly. If the fracture is comminuted or other than transverse, one of these methods will be needed for reduction and maintaining it until the plate is applied. You cannot depend on manual traction as it cannot be maintained constant enough. If the fracture line is transverse or only moderately oblique neither of these may be necessary.

The best incision is the external anterolateral with its center laid at the level of the lower end of the upper fragment. The incision should be ample, i.e., from 6 to 10 inches long, depending

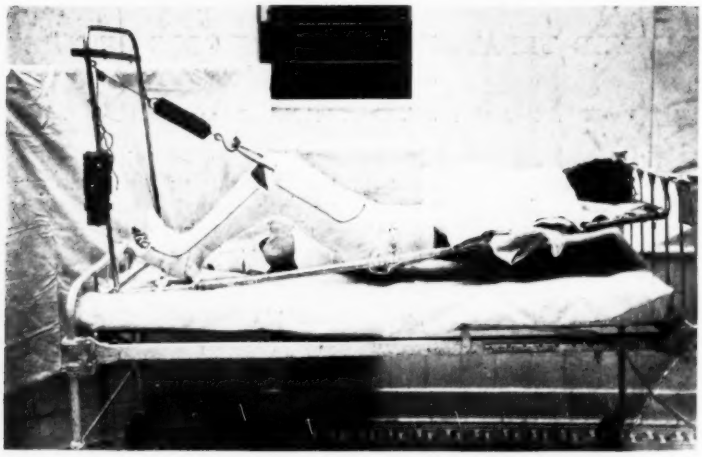

Fig. 1. Patient in fracture frame. Showing fish scales placed in rope between the limb and the pulley to indicate efficiency and amount of traction.

upon the case. Sew damp towels to the under surface of the skin edge. This is important in order that they may not be dislodged during subsequent manipulation.

Carry the incision down through the muscles, catching the bleeders as you go, until you open the hæmatoma at the fracture site. Remove the clots from the broken bone ends and the immediate vicinity. If traction will not reduce the shortening and the fracture is transverse or slightly oblique, grasp each fragment with a

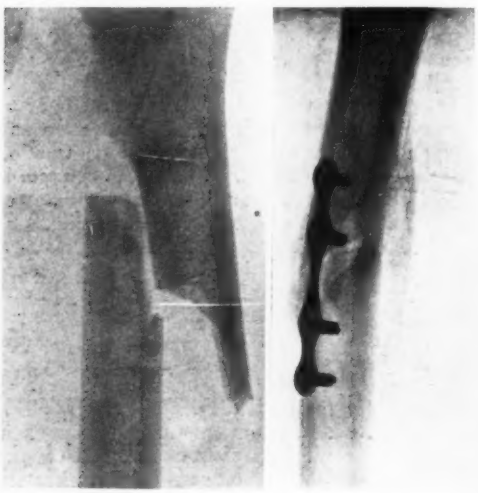

Fig. 2, a (at left). Case 1, after primary traction before operation. Unfortunately the roentgengrams which were taken later were lost during the moving of the X-ray department.

Fig. 2, b. Final result, Case 1.

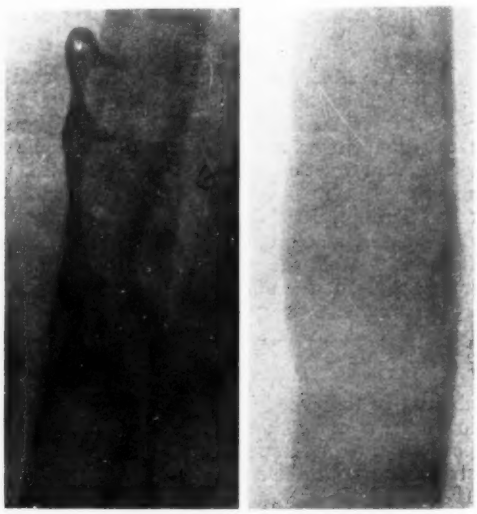

Fig. 3 (at left). Case 2, five days after plating. Note the loosening of the screws. This case did not have postoperative traction.

Fig. 4. Case 2. Taken at time of follow-up report. Almost all of the angulation has been corrected.

Fig. 5. Case 3. Before operation.

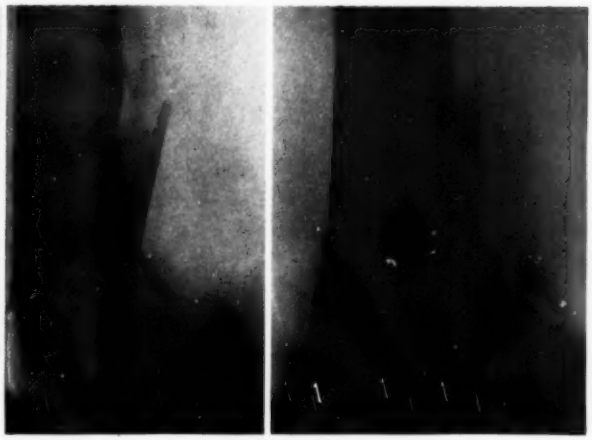

Fig. 6. Case 3. Four weeks after operation.

Lane forceps. Then have the assistant who has the leg in charge bend the limb away from the wound until the bone ends are angled out of the wound. After locking the ends one against the other, gradually straighten the limb, thereby reducing the fracture. This accomplishes reduction with the minimum amount of trauma, denudation of the bone and destruction of the blood supply. If it is found necessary to put a finger in the wounds, a fresh glove should be worn.

Fixing the fragments. Use a 4 to 6 hole Sherman plate and Sherman screws. From this point the limb should be maintained in the flexed position and one assistant delegated to be responsible that no undue strain is made on the plate and screws. Wire is not best except to encircle comminution. Bands can be used for long oblique and spiral fractures but I have seen some bad results from absorption of the bone ends and non-union. A fenestrated rubber tube, the size of a lead pencil, is placed in the dependent angle of the wound and reaching to the bone at a point an inch or two from the fracture site. The wound is now closed, skin included, with catgut. A heavy silk is passed through the exposed end of the drainage tube and the gauze dressings are split and applied, permitting the silk to come through all but the last layer, under which it is coiled and its position marked by a pill box top which will show its position through the plaster casing.

Maintaining this fixation is our next duty. The traction is now transferred to the bow which is attached to the frame which has been placed on the Hawley table previous to placing the patient upon it.

The patient is now enveloped in the plaster casing as described in the article noted above. From 12 to 20 pounds weight is added for the traction and this is kept on until the patient is out of the anæsthetic or better still for 24 hours. It is then gradually reduced in amount to 8–12 pounds as registered on the fish scales. The entrance and exit of the traction irons in the skin are protected by a cocoon of cotton sealed to the pin but not to the skin.

Forty-eight hours after operation, a small window is cut over the pill box, it is lifted out, the gauze layer cut, the silk found and by this means the drainage tube removed. This little technical point obviates the necessity of cutting a large window over the wound, a procedure which all too often results disastrously. For how often have we all seen the screws become loose and the fracture site angle into the fenestra, due to the absence of pressure, which should be afforded by the cast. The wounds and the dressings which will be seen to be stained with blood are now left alone as the catgut stitch will absorb.

I think this matter of drainage is very important as it allows exit to the postoperative bleeding and permits the periosteum to fall in its natural place around the fracture site instead of being floated back by a hæmatoma. In none

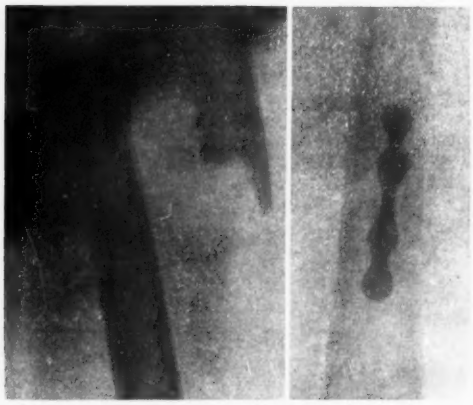

Fig. 7 (at left). Case 4. After ether reduction and cast.
Fig. 8. Case 4. Lateral view.

Fig. 9 (at left). Case 5. After two attempts at reduction, one under the fluoroscope.
Fig. 10. Case 5. Anteroposterior view.

of the 13 reported cases below, all of which were drained, was there either infection or non-union.

An X-ray, 2 views, is taken within the first few days. The patient being fixed on the transportable frame makes this possible without danger to the fracture. At the end of a week the plaster casing is cut away from in front of the leg thus leaving the leg and foot lying in a posterior molded splint. This permits daily motions of the ankle and knee which should be passive for the first 4 weeks. The muscle action is very essential to the blood supply. We have all noted how, in obtaining blood from a vein, the clasping of the fist augments the flow. The patient can attend to this with a bandage under the heel, then through a pulley and to his hand. Massage also should be given.

The position of the fragments must be checked up every 1 or 2 weeks by X-rays until union has occurred. The traction is maintained until union is firm and the flexed position is also maintained for from 5 to 7 weeks. This is of vast importance, for all too often have we seen plates and screws pulled loose and the original deformity return when these cases have been placed too soon in the flat position, without traction. Complete weight bearing should not be allowed for from 4 to 6 months in the adult.

The 13 cases reported below in detail, all, with one exception, were treated by the writer in the position of muscle equilibrium and with one exception with postoperative traction.

Case 1. J. D., age 11, admitted November 23, with history of being struck by an auto truck. On admission examination found a fracture of the right femur, laceration of the scalp and left thigh and cerebral concussion, mild in type. Dressing with traction and splints in the flat position did not result in reduction (Fig. 2, a). On November 24, open operation under ether and through an external anterolateral incision was done and a 4 hole Sherman plate was applied. A drainage tube with a silk pilot was used in the dependent angle of the wound. Adhesive traction of 10 pounds with the limb in the flexed position was used. A plaster cast was applied taking in the entire affected limb and pelvis and with a few turns made around the upper portion of the unbroken thigh after the manner of a pair of trousers with one short leg.

November 27, drain removed—wound clean.

December 18, skin grafting (Thiersch) on left thigh.

December 26, grafts all successful. On February 14, cast was removed and the limb rested on pillows, allowing the knee to straighten slowly. February 17, discharged, with union and no deformity. Advised to use crutches and report to surgical dispensary in 1 week (Fig. 2, b).

Follow-up report: Patient says he would not know his thigh had been broken.

Case 2. C. W., age 14, admitted September 30, having been struck by an auto. Examination found cerebral concussion, laceration of left eyebrow and fracture of the shaft of the right femur. A temporary Bucks traction and sandbags were applied to the broken limb until the patient's condition would warrant interference.

October 6, ether anæsthesia, reduction and posterior angled splint with traction. X-ray shows poor position.

October 16, open reduction was done through an external anterolateral incision using a 4 hole Sherman plate and a pilot drain. Limb was put up in the usual plaster trousers with one short leg on affected side but no traction was used as the fracture surfaces were so firmly dovetailed.

October 20, Figure 3, shows perfect alignment and end-to-end approximation. Due to a misunderstanding a 6-inch fenestra was cut in the plaster and the drain removed.

November 8, X-ray reports anterolateral bowling and a pulling loose of the two lower screws. This bowling was pushing into the fenestra.

November 10, cast removed and a posterior gutter splint with longitudinal and lateral traction applied.

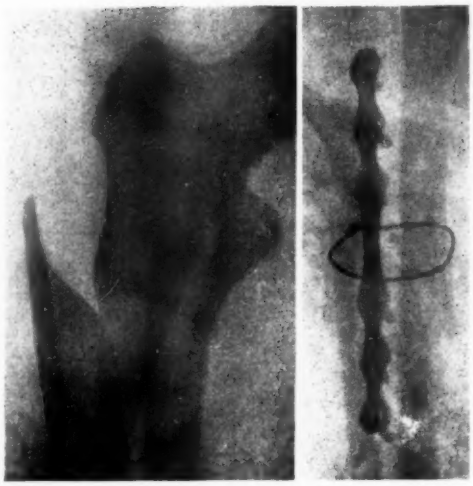

Fig. 11 (at left). Case 6. After primary traction for 24 hours.

Fig. 12. Case 6. Anterior view 3 weeks after operation. The light streak down the center is an artefact.

December 18, discharged. Union firm, excessive callus —¼ inch shortening.

Follow-up report 2 months later: Patient walks with a very slight limp, has ¼ (?) inch shortening and the wound is open, superficially. Three months later the loosened plate was removed, when the wound promptly healed. The next follow-up report later, shows no disability, no demonstrable shortening, no limp and Figure 4 gives the X-ray.

The patient does have, however, relaxed ligaments in his knee, allowing a slight "back knee" due to the prolonged traction exerted through the knee joint, illustrating the disadvantage of such traction. The condition does not inconvenience the patient in the least according to his own statement.

Case 3. J. G., age 24, admitted to hospital November 13, with history of having fallen 15 feet into a hole, striking on his knee. Examination shows a much distorted limb. There is shortening and great deformity. The lower end of the upper fragment has penetrated the quadriceps tendon just above the patella and presents beneath the skin. Limb dressed flat with straight splints and traction. X-ray showed a supracondylar fracture in bad position.

November 14. Open reduction through an external anterolateral incision. Steinmann nail traction added. It was found that the knee joint was opened by the upper fragment and that some comminution was present. A 4 hole Sherman plate was applied, a pilot drain placed, and 20 pounds traction added. The usual plaster trouser cast was applied.

November 16, drain removed.

November 21, anterior half of leg cast removed and slight passive motion of knee and ankle.

December 12, because of defects developing in the cast it was removed and a Hodgen splint applied with traction still acting.

December 14, Steinmann nail and traction removed.

A slight superficial infection was present around the entrance of the pin.

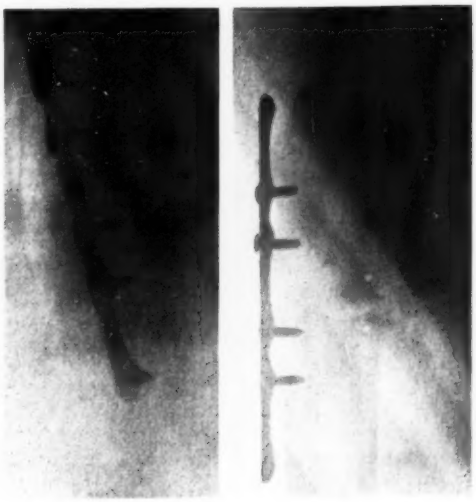

Fig. 13 (at left). Case 7. After operation.
Fig. 14. Case 8. After operation.

December 24, discharged with union; no deformity and no shortening and with about ¾ full knee motion—(Fig. 6).

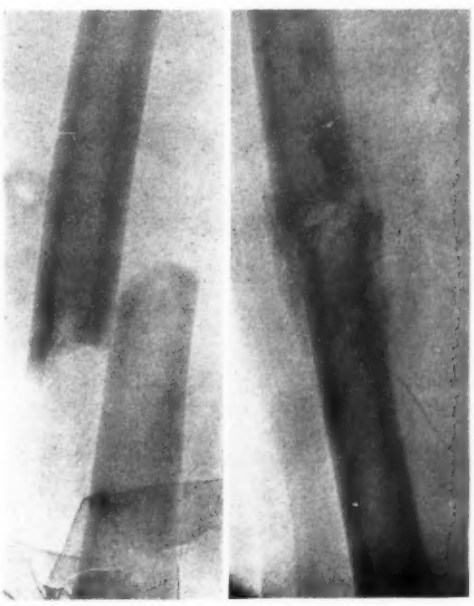

Fig. 15 (at left). Case 9. After 12 pounds adhesive traction in the Bryant position.
Fig. 16. Case 9. Lateral view.

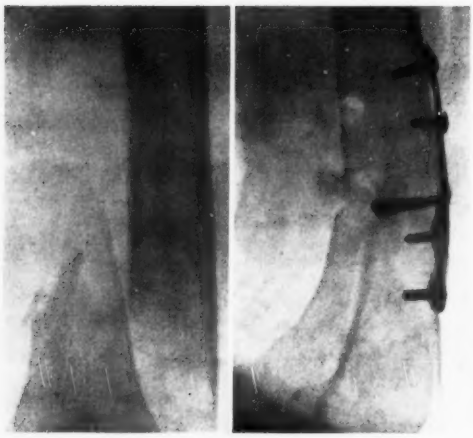

Fig. 17 (at left). Case 10. After reduction and cast in flat position.

Fig. 18. Case 10. Lateral view 3 weeks after operation. The wire loop was used to fix the external condyle.

Follow-up report: Patient says his leg is perfect. He has no lump, pain or limitation of motion. Lost time was 6 months.

CASE 4. I. C., age 15, admitted November 5, with a fracture of the middle of right femur. X-ray at once showed the usual deformity and overlapping.

November 6, ether and reduction and plaster cast showed no improvement (Fig. 7).

November 20, open reduction was done through external anterolateral incision, the fragments angled into position and a 4 hole Sherman plate put in and a pilot drain added (Fig. 8). Patient fixed in a flexed position in the trouser plaster cast on the modified frame, with traction, being applied by adhesive.

November 9, drain removed.

December 9, top of leg cast removed and it was found that the patient had a peroneal palsy. He was given a sling and pulley attachment for exercise.

December 20, cast removed and 5 days later the patient was discharged with solid union, no deformity, and walking on crutches.

Follow-up report: Patient has no deformity, shortening or joint limitation. He says his leg is perfect.

CASE 5. A. C., admitted May 24, with history of being hit by an auto. Left femur was found broken at the middle portion. Patient was given anæsthetic at once and reduction attempted. Fourteen pounds pull overcame the shortening, but crepitus could not be obtained. X-ray showed posterior position and shortening (Fig. 9).

May 26, Bryant treatment applied with 18 pounds traction.

May 30, X-ray reports the same deformity (Fig. 9). Attempted reduction under the fluoroscope disclosed the fact that something kept the ends from engaging.

June 1, open reduction was done through the usual e-a-l incision. A fibrous band attached to the linea aspera prevented reduction. A 4 hole Sherman plate was applied and a pilot drain put in place. Patient was put in the flexed position with plaster trousers and fixed in the modified frame. Adhesive traction with 10 pounds was added.

Fig. 19 (at left). Lateral view of Case 11, 15 weeks after fracture.

Fig. 20. Case 11. One month after operation.

June 12, X-ray reports good position.

July 4, cast was removed and the X-ray showed good position and union (Fig. 10).

July 13, patient discharged with solid union—no deformity and no shortening.

Follow-up report: Patient, 4 years after operation, walks without limp and states that his limb is as good as the other one.

CASE 6. H. A., age 34, admitted October 23, following an auto accident. Examination revealed a crescent-shaped laceration through the cheek, fracture of 2 ribs, 2 metacarpals, 5 phalanges and the right femur. The femur was dressed on a moderately angled double inclined plane with traction. An X-ray the following day showed a comminuted fracture (Fig. 10). Patient was dressed on a Hodgen splint and adhesive traction with no better results, despite 46 pounds of traction.

October 24, open reduction, e-a-l incision and with the aid of the Steinmann nail traction, a 6 hole Sherman plate and a wire for the comminution was used. Pilot drain placed in the wound. The usual plaster trouser and frame dressing with 20 pounds traction applied. Traction reduced to 12 pounds at end of 3 weeks. Cast cut out over the leg and a peroneal palsy found, which was, I think, due to a cinch traction that we used to pull with. Passive motion, massage, and electricity. X-ray shows good position (Fig. 12).

December 30, Steinmann pin out. A slight infection was found at the entrance of wound.

January 15, cast removed and 2 weeks later patient was allowed upon crutches, having solid union and no deformity. The peroneal palsy had disappeared.

Follow-up report: Patient states, 18 months after operation, that his limb is as good as the other. There is no deformity or limp. Time lost, 16 weeks.

CASE 7. M. G., age 46, admitted November 24, with a comminuted fracture of the middle of the shaft of left femur. After attempt at non-operative treatment with adhesive traction with poor result, open reduction was

Fig. 21. Case 12. Two months later than in Figure 20, showing solid union.

performed November 27; e-a-l incision, 6 hole plate, pilot drain, Steinmann traction, and a plaster trouser and frame dressing. Traction 12 pounds.

December 10, cast cut and knee and ankle motion started. Wound clean.

December 20, Steinmann nail out.

January 8, cast removed and solid union found with no deformity. (Fig. 13).

January 5, discharged in good condition on crutches.

Follow-up report: Patient states, 1 year after operation, that she has a good leg and no limp, but occasionally has rheumatism, which, however, she had before her accident.

CASE 8. E. Z., age 52, admitted March 27, with a subtrochanteric fracture of the left femur. The X-ray showed a very unique transverse fracture, with marked abduction of the upper fragment, evidently an operative case. Dr. E. Martin, assisted by the writer, performed open reduction, March 29, using 4 screws, Sherman plate and a pilot drain (Fig. 14). Steinmann nail traction, and 10 pounds. The plaster trouser dressing and the frame were used, with limb in the flexed position.

April 4, drain out, wound clean.

April 20, cast cut away and knee and ankle motion started.

May 13, traction removed—pin hole entrance infected.

June 18, patient discharged on crutches, with solid union and no deformity (Fig. 14). Measurement shows ¼ inch shortening.

Follow-up report: Patient reports that she has no trouble with her leg except occasional damp weather pains.

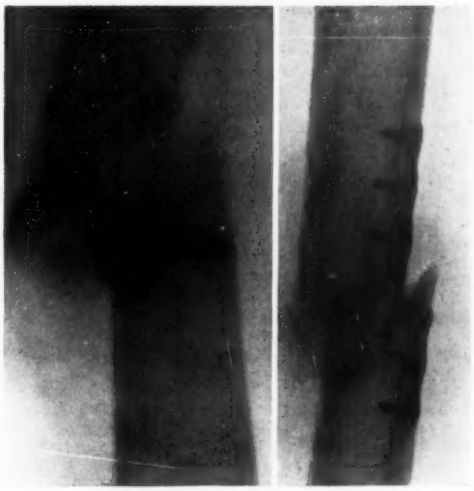

Fig. 22 (at left). Case 13. Anteroposterior view.
Fig. 23. Case 13. Lateral view 7 weeks after operation.

CASE 9. A. D., age 8, admitted November 28, having been struck by an auto, causing fracture of middle of the shaft of femur.

November 29, X-ray shows the usual deformity with overlapping.

November 29, Bryant treatment with 12 pounds, then 15½ pounds, with adhesive dressing (Fig. 15).

December 27, Steinmann pin and flexed position and suspension and 18 pounds traction.

January 29, pin removed because of deep infection.

February 6, pin wound into bone opened for osteomystitis.

March 25, discharged on crutches with solid union, but with a flexed knee.

Follow-up report: Patient has a good useful leg with no shortening and no deformity (Fig. 16). The osteomyelitis was some months healing but she now has no complaint. Joint motion is normal.

CASE 10. H. F., age 56, admitted to hospital with a supracondylar fracture of left femur. Before admission the patient was dressed in a plaster cast in the straight position with poor result (Fig. 17). On November 29, 2 weeks after the accident, open reduction was done. The fracture was found to be a Y type, comminuted and opening the joint between the condyles. A 4 hole plate and wire was used and a pilot drain inserted. In view of the local condition a bone traction was not used. The plaster trouser cast was applied.

December 3, drain out; wound clean. X-ray taken 3 weeks after operation shows good position (Fig. 18.)

December 15, cast cut out and knee and ankle motion begun.

January 19, cast removed, union solid, a slight genu valgum present due to slipping up of external condyle.

February 1, knee joint free, but the quadriceps being adherent at the fracture site interferes with flexion and extension about 50 per cent.

March 20, patient walking with help of crutches using the limb as a partial weight bearer, and improving rapidly at this time of writing.

November 11, patient walking unaided. Joint action near normal.

CASE 11. C. Y., age 16. When patient first came to the writer's attention, she gave the history of having had her right femur and the upper end of her fibula broken in an auto accident 15 weeks previously. On examination, September 21, '20, it was found that she had 2 inches shortening, a very pronounced angulation deformity and fibrous union. The X-ray, Fig. 19, showed angular overlapping. On September 27 an open reduction was performed. Through the e-a-l incision the ends of the bone were freed and angled out of the wound. The ends were sawed transversely, sacrificing between ½ and ¾ inch *in toto*. Engaging one extremity against the other the limb was slowly straightened, consuming about 10 minutes for the completion. Consequently the patient was not shocked, as always happens in old shortened cases if traction is done hurriedly. A 4 hole Sherman plate was inserted, also a pilot drain. Plaster trouser cast and traction on the frame was employed.

September 30, drain removed, wound found clean.

October 15, the cast was cut out and motion of the knee and ankle started. X-ray taken October 26 shows the fragments in good position (Fig. 20).

November 20, cast removed. Two weeks later the patient was around on crutches using the limb as a partial weight bearer. Union was solid.

Follow-up report: Her physician writes me 6 months after the operation that she has a good limb, with a scant ½ inch shortening and walks without a limp.

CASE 12. M. L., age 18, admitted January 2, having fallen down a ship's hold and fractured his right femur and left tibia, and fibula. X-ray shows a comminution through and below the trochanters, as well as the shaft fracture. The patient was an underfed, emaciated, anæmic boy, and it was not deemed wise to do an open reduction. The limb was put up in a Hodgen splint and the Steinmann nail traction used. Knee and ankle motion started in 3 weeks. Figure 21 shows the result after 2 months in bed.

April 23, patient was discharged with no deformity and solid union with ¾ per cent knee motion. This case is not really one of the series. It is merely used as illustrating bone traction. Follow-up report unobtainable.

CASE 13. W. N., age 54. Compound fracture of the middle of the femur. Dressed temporarily with adhesive traction and suspended Thomas splint for X-ray.

August 23, patient removed the traction. X-ray showed overlapping and lateral displacement of the lower fragment (Fig. 22). Operation was performed through the e-a-l incision. The fragments were angled until they dovetailed into perfect approximation, so perfect that it became a question as to whether to plate or not. Experience with such cases indicated a plate, and in this case using a 6 hole plate, not having a 4 hole one boiled up. Drainage and the trouser plaster cast with Edmonston long traction carrying 25 pounds.

August 14, weight reduced to 20 pounds.

August 15, drain removed.

August 20, wound clean.

September 1, foot and ankle freed for movement.

September 12, cast and tongs removed, suspended in Thomas splint and X-rayed (Fig. 23).

October 7, union firm—no shortening, crutches.

October 23, perfect foot and ankle motion, flexion at knee still 50 per cent reduced. X-ray photographs comparable to those taken 5 weeks before, except showing more callus.

December 19, follow-up report: Patient says his limb is fine. He walks without limp, has no demonstrable shortening or other deformity. Ankle motion normal; knee has complete extension and about 70 per cent flexion.

I think Figure 23 shows most conclusively that postoperative traction is absolutely essential. This plate was broken while applying the cast; suspected because of an audible snap. The X-ray was not taken sooner because of mechanical difficulties. The fact that the fragments slipped from the true dovetailed position into a false one proves that the displacement occurred before callus or fibrous tissue deposit, which would permit of angulation rather than a distinct lateral displacement. This bears out the experience in other cases, namely a loosened plate results from the screws pulling out 10 days to 2 weeks after operation, broken plates occur at time of operation. Despite the broken plate before any union had occurred, traction maintained axial alignment perfectly.

The above series is not a selected one, but is composed of those cases, 11 in number, in hospital and private work, in which what we might term the combined treatment was used, namely internal and external fixation with same type splint (plaster in this series), and the continued employment of traction. It is poor surgery to plate or wire a fracture and then not give it the benefit also of the proper state of muscle equilibrium which is only accomplished by fixation, position, and traction.

If, however, circumstances do not permit open operation, the next best treatment is suspension and direct bone traction, of which Cases 9 and 12 are examples. In both of these cases the direct bone traction had to be used as the adhesive proved inadequate.

SUMMARY

1. In the 11 operative cases all were drained and no infections occurred.

2. No case had a bad result; the greatest shortening was one-fourth inch.

3. But one plate had to be removed and that was due to 2 errors, i.e., too large a fenestration and no traction.

4. The follow-up reports after months, and in a few cases, years, show no changes for the worse and no plates have had to be removed.

5. Every one of the 13 patients had a first-class limb, with no limps and joint limitation, but slight in 2 cases.

CONCLUSION

Judging by this small series, the best treatment for fracture of the shaft of the femur is the continued use of internal and external fixation in the full sense of the word. It gave 100 per cent good results.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
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OCTOBER, 1922

RADIUM TREATMENT OF UTERINE FIBROIDS

EXPERIENCE has established the fact that radium is the best known remedy for selected cases of uterine fibroids. Uncomplicated symmetrically developed fibroids, not larger than a uterus of three or four months' pregnancy in women near the menopause, are successfully treated with radium. One thousand two hundred to one thousand eight hundred millicuries (milligram hours) of radium element, thickly screened, is advised. One thousand eight hundred usually produce no more symptoms than one thousand two hundred millicuries, and are almost certain to produce a permanent menopause, except in younger women. Re-establishment of menstruation, in our experience, has resulted in renewal of growth and recurrence of symptoms.

The radium should be placed within the cavity of the body of the uterus. One and occasionally two menstruations may follow the treatment before amenorrhœa results. Atrophy of the tumor commences about the eighth week. In four or five months the tumor may be felt as a small nodule, but has usually disappeared, or has become so small that it cannot be palpated.

Intramural fibroids are best suited for radium treatment but subperitoneal and even submucous do not necessarily contraindicate its use.

Intra-abdominal complications especially chronic infections indicate surgical treatment. When cases which are complicated with chronic pelvic infection are treated with radium, there may result reinfection and abscess formation.

The objection to the use of radium in larger tumors is chiefly the danger of mistakes in diagnosis. When radium is used the diagnosis should be frankly certain; the fibroid uterus should be one that can be freely rolled between the fingers on conjoined palpation.

Success in radium treatment necessitates production of a permanent menopause. This fact is the principal reason for use of the thick screen. The thick screen does not materially increase the amount of radium required to stop ovulation, but lessens materially the amount of necrosis at the site of radiation and thus lessens the dangers of infection and the amount of the thin watery discharge that results.

In younger women it is preferable to remove the fibroid growth by means of surgery rather than to destroy the function of the ovaries by radium.

The limitations to the use of radium may be extended in cases of poor surgical risk.

The nervous disturbances associated with the menopause following radium, in our experience, have been about the same as those after the natural menopause.

THOMAS J. WATKINS.

INTRA-ABDOMINAL AND INTRA-VISCERAL PRESSURE

SURGEONS are prone to take a materialistic, mechanical, "two times two is four" view of things, often to the exclusion of important principles. Every surgeon, in operating upon asthenic patients with general abdominal ptosis, has observed the dilated and atonic condition of the stomach, bowels, ducts, and even blood vessels. Without serious thought, he has often acceded to the neurological view that the case represents some obscure form of neurological or nutritional dyscrasia.

The well-known and efficient Weir-Mitchell rest cure and forced-feeding treatment for neurasthenics was based on the presumption that rest plus padding of the irritable nerves with fat brought about the good results. In the Muetter lecture for 1913, I showed a number of roentgenograms illustrating the difference in size, motility, and position of the hollow viscera before and after fattening, which were very striking. In many instances of patients with dilated, atonic, dropped stomachs, who had been fattened, the stomach had been lifted to its normal position, normal peristaltic waves had been restored and the size of the stomach had been reduced by half. My theory as to the cause of this change was that the deposit of fat in the abdominal cavity enclosed by relatively inelastic walls had greatly increased intra-abdominal pressure and at the same time had thickened and shortened the mesenteries. Nine additional years of intensive study of a much larger number of cases has firmly developed this assumption into a conviction.

Up to 1909, more than two hundred and fifty articles had been written of experimental work on implantation of the ureter into the bowel. No successful series had been reported. All methods had failed because of so-called "ascending infection." All attempts had been along purely technical lines. During 1909, in the course of experimental work on the pancreas, I discovered that bile ducts transplanted into the intestine by direct methods always dilated. Dissection of the duct of a normal dog's duodenum showed that it traversed the space between the mucous membrane and muscle for some distance before entering the bowel. I assumed that intra-intestinal pressure, exercised on the mucous membrane overlying the duct, normally closed it against direct entrance of intra-intestinal pressure into the duct. This was proven by transplanting ducts to a similar position under the mucous membrane by operation, when it was found that no dilatation took place. Similar experiments proved that the ureter could be successfully implanted in the same way. The kidneys, ureters, and intestines of five dogs with healthy kidneys and undilated ureters, following operations from 2 to 6 months, were presented before the American Medical Association in 1910. C. H. Mayo has now implanted more than a hundred ureters clinically by the submucous method with remarkable results. Smaller series of equally successful cases have been reported by Lower, Hunner, myself and others. We believe these results can be explained by static intra-intestinal pressure brought to bear on the mucous membrane overlying the duct.

The circulating fluids of the body are propelled through elastic tubes by intermittent muscular contraction acting as the *vis a tergo*. In order to maintain the ground gained during intervals of contraction, mechanical valves have been used; for example, the valves of the heart, the veins, ureters, bile duct and the ileocæcal valve. By the use of these valves, combined with muscular action, fluids may be delivered from a cavity of a lower to one of higher intravisceral pressure. For example,

the ileum, with a relatively lower intra-intestinal pressure, may permanently deliver fluid into a distended large intestine of much higher intra-intestinal pressure, if the ileocæcal valve is perfect. Bile under low pressure may be delivered from a relatively non-muscular bile duct into the duodenum of much higher pressure under certain circumstances provided the mucous valve protecting the end of the duct is good.

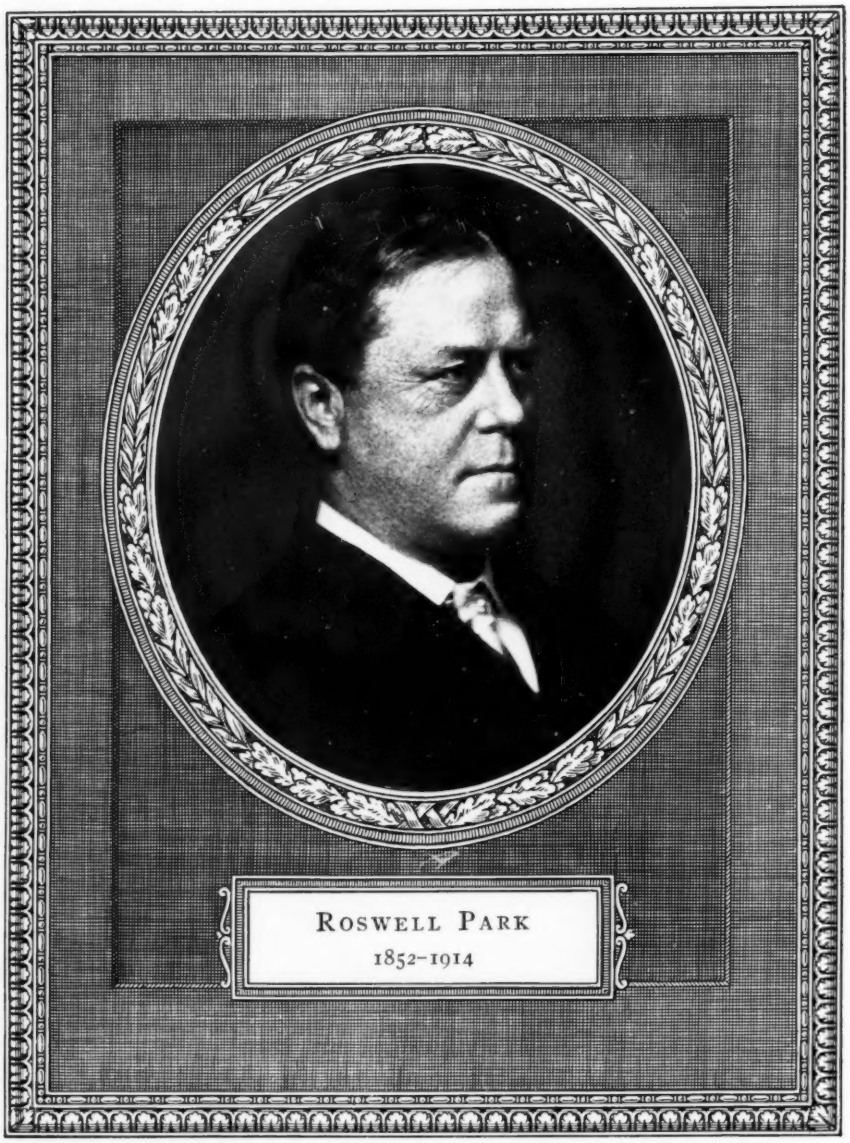
Every surgeon has noted that a biliary fistula ceases to discharge during the day some time before it ceases at night. Kehr, noting this, fed his patients frequently during the night and found, when he did so, that the flow of bile was the same night and day. Terry feeds his patients frequently night and day following cholecystectomy, to prevent the dilatation of the common duct.

Every surgeon has noted that when the gall bladder is removed or becomes functionless, the common and hepatic ducts dilate. Judd and others believe that the sphincter of Oddi is entirely responsible for this. While conceding the importance of this muscle, I do not believe it is entirely responsible or even the chief agent. Dilatation takes place when the duct is planted directly into the intestine without the sphincter of Oddi. It is probable that if the peristaltic waves of the duodenum could be maintained during most of the 24 hours, dilatation would not take place.

The question may be asked, how does an implanted ureter or bile duct containing fluid under low pressure permanently deliver its fluid into the intestine of much higher pressure, and particularly if there is no great amount of muscular tissue in the former? How does an undistended small intestine permanently deliver fluids and gas under relatively low pressure into an obstructed large bowel in which the cæcum is distended almost to the point of devitalization? Such a thing, of course, can only take place in the presence of a perfect valve. The only possible explanation for this is that a peristaltic wave passing beyond the valve reduces the intra-intestinal pressure immediately in its wake. This permits of delivery of the fluid from a low pressure organ for the time being. The valve holds it until another peristaltic wave makes another relaxation and thereby makes the delivery permanent.

For practical purposes, it may be stated that the ileocæcal valve is formed by an intussusception of the end of the ileum through a hole in the side of the cæcum plus excessive development of a flap of mucous membrane at its end. This intussusception is normally fixed, and the valve should be competent. The valve is for the purpose of protecting the small intestine against the greater gas pressure formed by the bacterial digestion of the large intestine. In some cases of asthenia with marked constipation and gas dilatation of the cæcum combined with reverse peristalsis, the intussusception is reduced and the valve destroyed, with the result that the fetid gas of the large intestine pushes back into the small intestine and in some instances reverse peristalsis of the small intestine seems to be established. In such cases an opaque enema travels upward even to the upper portion of the jejunum. Such patients often have a great deal of distress in the abdomen with marked evidences of general toxæmia. Lane's ileosigmoidostomy for intestinal stasis produces this same result by the absence of the valve, in that the greater intra-intestinal pressure of the large bowel gradually distends the ileum, no matter whether the distal ileum is excluded or not. The operation is unsatisfactory. Toxic symptoms are only temporarily relieved. An additional colectomy produces better functional results but is very dangerous and not desirable. Medical management is successful in most cases. In some instances, however,

it is necessary to shorten the supports of the ascending colon and suspend the transverse colon by omentum in order to bring the organs in proper position for food functioning. The medical treatment consists of increasing intra-abdominal pressure by fattening and appropriate exercises for strengthening the abdominal wall, increasing peristalsis and bowel action by paraffin, agar agar, and bulky foods. Increased intra-abdominal pressure brought about by deposition of intra-abdominal fat, counteracts the intravisceral gas pressure, allows the muscle fibers to shorten and thicken, after which normal peristalsis is more easily established. In an individual with normal intra-intestinal pressure, normal intra-abdominal pressure, normal gastro-intestinal motility and bowel action, the ileocæcal valve is not so essential and ileosigmoidostomy is not followed by abnormal dilatation of the ileum or troublesome reverse peristalsis into the dead end of the cæcum as is seen in so-called stasis cases. In rare instances, it is necessary to restore the valve by reproducing the intussusception. Kellogg's method is very successful in some cases. R. C. COFFEY.



ROSWELL PARK
1852–1914

MASTER SURGEONS OF AMERICA

ROSWELL PARK

DR. PARK was born in Pomfret, Connecticut, in 1852. His father was a man of note, having degree of Master of Arts from Union and Hamilton College, and Doctor of Divinity from Norwich University. Later he was the founder of Racine College in Wisconsin. Dr. Park's early years were spent in New England. He received his college degree in Racine College and his M.D. from Northwestern University. He was house surgeon in Cook County Hospital, Chicago. After filling various teaching positions in Chicago, he went to Europe for post-graduate study.

This European trip had a very remarkable effect on his later life. It was just at the time medical Europe was greatly excited because of the work of Pasteur, Lister, and finally Koch. He entered Koch's laboratory and there secured the foundation of his *Muetter Lectures* in Philadelphia, which later played such an important rôle in spreading surgical pathology in America. When he returned to America, he was an exceedingly well-trained man, and well fitted for his future career. The professorship of surgery in the University of Buffalo had just become vacant, and by the most fortunate circumstances for Buffalo, he was invited to the chair and accepted in the year 1883. He was destined to add further luster to that long list of such eminent men connected with the University of Buffalo, as Austin Flink, Frank Hamilton, John G. Dalton, James P. White, Hadley, Whithaus, and Edward M. Moore.

At this time surgery was in a sorrowful condition. Infections were the usual result of any interference. Modern surgical pathology was almost unknown. Upon this dismal surgical scene in Buffalo appeared Roswell Park, young and vigorous, handsome, a good mixer, musical, and exceedingly well trained in his profession. There was no possible escape from the brilliant career which awaited him.

Dr. Park was a prolific writer. His textbook by American authors largely written by himself was a two-volume work of which two editions were published. His *Modern Surgery*, a single volume containing over eleven hundred pages, published in 1907, stands today one of the most complete one-volume works in surgery. An epitome of the history of Medicine and the Evil Eye were among his book publications. From the year 1882 until his death about one hundred

and fifty papers were written on timely subjects. In 1882 he wrote one of the very first papers in this country on antisepsis. In 1884 and 1885 he wrote a series of papers on tuberculosis, giving accurately present-day description on bone tuberculosis. He was one of those who early insisted that pathological process in tuberculosis of bone and tuberculosis of lungs was one and the same. In 1888 he wrote a monograph on surgery of the brain which was one of our earliest publications on the subject.

Dr. Park was not gifted in research, but read widely and developed a wonderful faculty of early recognizing the importance of new subjects. His very early papers on antisepsis, tuberculosis, X-ray, and radium are wonderful examples.

As a teacher his fame was well deserved. No one attended his Clinic but went away impressed. He was very particular about correct English in his written and spoken word. His delivery was free and pleasant. He never failed to be entertaining by introducing a suitable story. His wide knowledge of the allied sciences served him well because of his ability to use that knowledge in illustrating strictly surgical subjects.

In the operative theater he was always a master. He had wonderful poise in the presence of difficulties. His technique was excellent, at a time when that was the unusual thing. He had excellent surgical judgment.

He worked untiringly for Buffalo institutions; the Buffalo General Hospital was almost his home. He devoted the best he had to make it one of the finest institutions of the kind in this country. The University of Buffalo was ever on his mind. Through many long weary years he struggled for a greater University in Buffalo. One of the sad things was he did not live to see the fulfillment of his efforts. Six years after his death twenty-four thousand citizens of Buffalo contributed over five million dollars—in ten days time—to establish that University for which he had worked so consistently.

In reviewing the work of such a man, sufficient time has not elapsed to give one the proper perspective. His chief work will probably lie in promulgating the knowledge of—first, antisepsis, and second, the general principles of surgical pathology. Both of these subjects were fairly well understood in Europe, but in those days America was not only a poor copier but a late one. His lectures on surgical pathology, usually spoken of as the "Muetter Lectures," did more to place the correct pathology of surgical disease before the American profession than any other publication with which I am familiar. His early publications on surgical tuberculosis, more particularly that of bone, was far in advance of most other writings in America. Years later the profession was arguing whether these bone lesions were really the same process as occurred in the lung. In 1886 he did the first deliberate trephining in America where accurate localization was previously outlined. It was a case of cyst, following hæmorrhage and was operated in the Buffalo General Hospital.

Probably one of his greatest contributions to medicine will be found in his activity in founding the Gratwick Laboratory. He was the first man to realize and put into practice the advantages of a thorough investigation of the problems relating to cancer. Through his efforts, and those of his friends, he was able to establish a small laboratory in this college for that purpose. The beautifully equipped laboratory and the handsome hospital, known as the New York State Institute for the Study of Malignant Disease, at 113 High Street, is the end-result. While others have since been more active in this work than he, yet I believe the credit of starting it belongs to Dr. Park.

Most men have fads and hobbies which steal their time, but he had few if any, unless music might be so considered. He played the piano a little quite well. He, with many others, gave freely of his time and money to start the first good concerts given in this city. He was president of the Philharmonic Society, and under his r´gime the now famous May Festival was inaugurated. These were self-sacrificing undertakings, because almost invariably they were a financial loss. It was worth it, however, because I never knew any one to get such keen enjoyment out of a good concert as he, and in later years, when most things failed in interest, his idol—music—still held him steadfast.

During his entire career, he had a certain pride in buying books, and often this trait made him the victim of the over-zealous bookseller. In the end, he developed a very highly prized library, probably the equal of any private library in this section of the country. In it are many very rare books, besides a really wonderful collection of surgical reference works, for instance complete sets of *Annals of Surgery* and *Zeitschrift fuer Chirurgie*, *Centralblatt fuer Chirurgie*, *Archive fuer klinische Chirurgie* and *Index Catalogue of Surgeon General's Library*. This library is now, by his will, the property of the University of Buffalo.

If we measure success by honors, the fates were exceedingly kind to him. At some time during his life he was president of the Academy of Medicine, American Association for Advancement of Science, State Society, American Surgical Association, Society of Natural Sciences, the Buffalo, Saturn, University and Liberal Clubs. He was a member of the German, Italian, and French Surgical Societies. He was the American representative on the international committee of the International Society, from its inception up to the time of his death. He was appointed by Theodore Roosevelt a member of the visiting committee at West Point Military Academy. He received an honorary degree of M.D. from Lake Forest University, A.M. from Harvard University, and LL.D. from Yale. In 1890 he was called to the chair of Surgery in Rush Medical College, but decided to continue in Buffalo. In 1908, on the twenty-fifth anniversary of his professorship of surgery in the University of Buffalo, the profession made him the guest of honor at a dinner, which was a most remarkable gathering of about one hundred and fifty persons, including surgeons of note from the United States and Canada,

He was given a beautiful loving cup, and later a handsome volume was edited as a memorial of the dinner.

His personality was remarkable, and his self-control under trying circumstances was the wonder of all who knew him. His courtesy to all was never failing. He was a good friend, admired by all, loved by many, and hated by none. His personal influence upon the young men of the community was not to be measured lightly, and his standard of honor wielded a power for good, far beyond the privilege of most men. While his surgical influence was the greatest possible, I firmly believe his greater good lay in his ability to train those around him, to be real, honorable, upright gentlemen. His influence in this particular will live on and on, and will ever hold memory dear, far beyond the mere passing of a great man.

EDGAR R. MCGUIRE.

CORRESPONDENCE

AMPUTATION STUMPS AND THEIR ADAPTATION TO ARTIFICIAL LIMBS

To the Editor: The article with the above title in the April, 1922, issue of SURGERY, GYNECOLOGY AND OBSTETRICS by Dr. Carl Bearse gives us, I believe, most of the important points that we gained from our experience with amputation cases during the war. It affords me much pleasure to support practically all of his arguments. There are one or two points, however, in regard to which I think we must say that our war experiences led us to a somewhat different conclusion. Also I wish to emphasize much more than he does the importance of the early use of the temporary leg or pylon, and to illustrate by photographs a method by which this temporary leg may be used.

First of all I believe we should object to amputation through the knee joint. In the few such

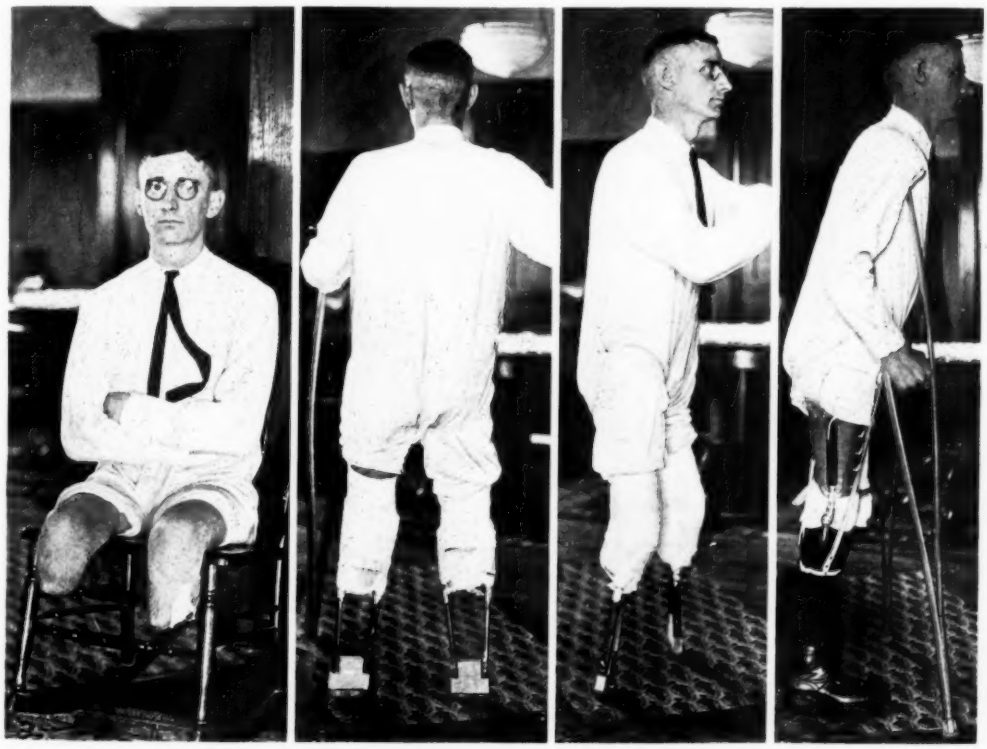


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. Mr. M. Double leg amputation, December, 1921, because of severe deformity and chronic ulceration of both feet. Age 36. Occupation, jeweler. Left leg stump not quite healed at end of 6 weeks.

Figs. 2 and 3. Plaster bucket pylons put on right leg, February, and left March. Began walking on right pylon alone practically at once and walked very well on the two pylons (short) in 2 weeks.

Fig. 4. Permanent right artificial limb put on about April 1. Patient able to go about on the street at once—largely as a result of his preceding 6 weeks on temporary pylons.

cases I saw, the stump was always unsatisfactory, and the application of any leg extremely difficult.

Another point with reference to the selection of the site for amputation is that arm stumps and above knee stumps should in general be as long as possible. Even when it is necessary to depend upon skin traction to cover the end of the bone, as much bone should be saved in these stumps as can be. So much of the usefulness of artificial limbs in these cases depends upon additional leverage, that even an extra inch or so should be saved if possible. This point should always be borne in mind. In the after-treatment of all amputation cases, this point of traction on the skin should be remembered. This is especially true if there is any difficulty about covering the end of the bone, or in the matter of securing good healing of the skin edges. Skin traction by means of the modified Thomas splint, or in some other way as described by various writers, will often serve to cover these stumps, even when the bone on first observation seems too long. Even in the case of infection and sloughing, primary or secondary shortening of bone should not be done until a thorough attempt to lengthen the soft parts of the stump by traction has been made.

With regard to the use of the plaster-of-Paris bucket temporary leg or pylon, this is something regarding which I learned a good deal during my association with Sir John Lynn Thomas, of Cardiff, who was chief surgeon to the Prince of Wales Hospital for Limbless Men, and Major Alwyn Smith, who was in charge of the Orthopedic Center at the Welsh Metropolitan War Hospital. In our work at Savenay also, where Major Phillip D. Wilson was in charge of the amputation cases, hundreds of these pylons were put on.

These temporary pylons, as illustrated in Figures 2 and 3, can be put on within 2 or 3 weeks of the time of amputation. They enable the patient to walk practically at once, and what is more important, prepare the stump, both by exercise and pressure, for the wearing of the regulation leg a little later. In amputations close to the knee, such a plaster bucket above the knee with the leg extended, and with the limb being used daily, is the surest safeguard against flexor contraction, which is otherwise often difficult to prevent.

Stump bandaging and massage are also eliminated by having such a leg worn up to the actual time of applying the final artificial limb.

In the first case of which photographs are submitted herewith, the amputation was done by Dr. M. S. Henderson of the Mayo Clinic in December. I applied the first plaster bucket pylon in February, and the second a few weeks later. The first permanent artificial limb is now being worn, (April 4), and the other will be ready in a week or two. This man has had no contraction deformity; in fact no trouble of any kind.

The other case has quite a different history. He was amputated in February, 1921. He had a dislocation of the hip, which was not reduced until some time after the amputation (August 20). In February, 1922, he was supplied with an artificial limb. There was considerable contracture deformity of the knee and his hip was still tender. He continued to walk on crutches and made an effort to use the artificial leg until March 22. The artificial limb was never of any use for weight bearing. In the meantime he developed a badly pronated foot on the other leg. He was given an anæsthetic on March 30, the flexed knee was straightened and a plaster-of-Paris bucket with a peg leg put on. Whereas the artificial limb had been about 2 inches short, this pylon was made full length. The pronated foot was corrected, and put in plaster. Now with a handicap of an inverted foot in plaster-of-Paris on his good leg, and a plaster bucket extending to above his knee on the amputated leg, he already walks better in a week's time than he has ever been able to do since his amputation.

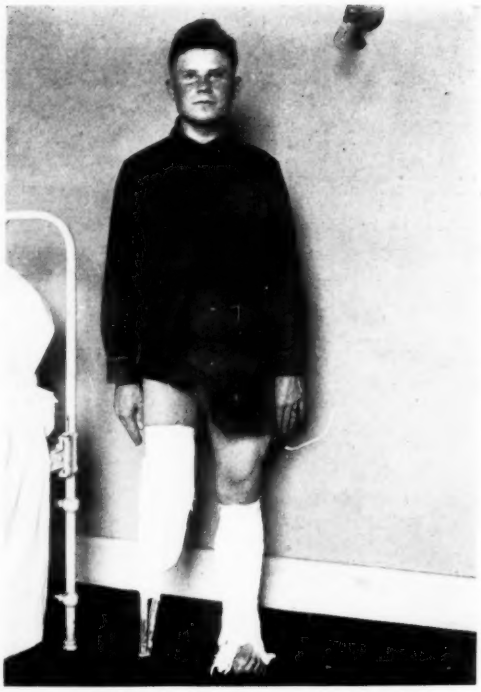


Fig. 5. Case 2 after application of pylon and leg cast.

This final case is an argument for three things: first, early correct application of a temporary leg after amputation; second, protection of the foot on the opposite side against pronation; and third, application of the permanent artificial limb only after suitable preparation of the stump.

H. Winnett Orr, M.D., F.A.C.S.
Lincoln, Nebraska.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD MAY 5, 1922, DR. DEAN D. LEWIS PRESIDING

EXSTROPHY OF THE BLADDER

DR. JACOB FRANK: More than 25 years ago I made some experiments on animals in treating exstrophy of the bladder, anastomosing the bladder of the dog with the rectum. At that time I transplanted the ureters for the purpose of finding out whether there would be an ascending infection. My experience showed that in every case where the anastomosis was made to the bowel, there was ascending infection. After making vesicorectal anastomosis in the dog, a year later I brought the dog before the Chicago Medical Society. Dr. Herzog made the bacteriological studies, and it was found that where vesicorectal anastomosis was made, and the openings of the ureters were not destroyed, the kidneys were sterile.

These specimens are now in a museum in Paris; I took them over there 22 years ago at a meeting of the International Medical Congress.

The dogs I operated on were very interesting in this respect: when they wanted to urinate, when they could not urinate through the natural channel, they squatted down like a bitch and urinated through the rectum. The act of urination and of defæcation was controlled separately.

As long as the openings in the ureters are intact the kidneys may remain sterile. Where the openings are destroyed the kidneys are absolutely infected in all cases.

RECURRENCES FOLLOWING OPERATIONS FOR INGUINAL HERNIA

Dr. William Hessert discussed recurrences following operations for inguinal hernia. (See p. 431.)

DISCUSSION

DR. WILLIAM FULLER: The so-called sliding and direct herniæ are notoriously difficult to cure surgically regardless of the method employed. It seems to me, however, that it is not these herniæ, for the cure of which the surgeon should be held responsible, but the oblique inguinal hernia, the hernia in which there is also frequent recurrences. The reasons for failure in the former herniæ are plain and understandable; in the latter herniæ, they are not.

The percentage of failures in every surgeon's work is higher than he would like to admit, or possibly knows. There is a reluctance on the part of many patients to return to their surgeons after unsuccessful herniotomies to complain that the work was not satisfactory. Other patients move away, or for various reasons find it more convenient to consult other surgeons, or possibly none at all.

The status of this question will reveal itself to any one consulting from time to time the surgical instrument makers and truss manufacturers, as I have made it my business to do the past few years. They tell me that almost daily somebody whose hernia operation was not a success applies to them for a truss. Frequently emphasis has been laid upon the fact that as many such reports come from the big surgeon's work as from that of men less well known. The number of patients I see with uncured herniæ is a good index to the number of my failures which wander away and go to other surgeons.

As I see it, there is no single factor that will fully explain the failure to cure a hernia. It seems to me that it may be one of many factors. It may be due to a low ligation of the hernial sac, although Coley disputes this, or did; it may be due to ligatures and sutures tied too tightly or too loosely; to wound infection or one that heals unkindly; or to a patient's leaving his bed too early and returning to the kind of work which had much to do with the production of his hernia.

Dr. Van Sweringen and I did several hundred hernia operations during the war, from which we should have learned some valuable lessons, but personally I can not say that much was really learned. A thing noted in war surgery, seen also in civil surgery, was frequent instances where perfect anatomical development of hernial structures could not be questioned. The operations when smoothly and seemed technically perfect. The wounds healed promptly and the patients were not hurried from their beds; yet many such herniotomies proved prompt failures. Again herniæ were met with where structural development was not complete; where the operations did not go so well; the wounds healed less kindly, some even becoming infected, yet many of these herniæ did not recur.

Dr. Hessert has long dwelt upon the occasional absence of the conjoined tendon, an observation I have not made, due probably to oversight or lack of proper care. The conjoined tendon is a more conspicuous structure in some patients than others,

as has been noted by many surgeons, and this feature alone would argue strongly for its possible occasional absence altogether. I believe the strongest point made in the paper is the one of "individualizing" in hernia operations. This I am sure is not always done in the best hands, and rarely, if at all, in other hands. It should be admitted, however, that to exercise this feature with telling effect will not always be possible.

It would appear, therefore, that a careful study should be made of every hernia and that that operation selected which will prove the most useful in that particular instance. Careful handling of all tissues; perfect hæmostasis; high ligation of the hernial sac; obliteration of all dead spaces, especially those likely to appear in the lower part of the wound; structures evenly and accurately approximated by sutures and ligatures tied with precision; and what seems as important as any other item, not allowing the patient to leave his bed until wound healing is strong and complete, or return too early to that environment or employment which might have had much influence in the production of the hernia. Close observation and adherence to these with other features that may arise in hernial operations will have something, no doubt, to do with a perfect and permanent restoration of most herniæ, regardless of whichever "method" one chooses to employ. Nothing will probably lead the average surgeon into trouble and disappointment more quickly than the employment of "methods" and shows nowhere more quickly and decidedly than in his operations for hernia.

DR. VERNON C. DAVID: I desire to mention one point in connection with sliding herniæ. While the mesentery of the bowel forms a part of the sac, it is not infrequently possible to find some portion of the sac which is parietal peritoneum. This can be opened, extending the peritoneal incision up above the internal ring, so that we virtually have a laparotomy incision parallel to Poupart's ligament, and it will enable us to turn over the sliding portion of the hernia into the abdomen and imbricate the free portion of peritoneum over it, so that the hernia is reduced by imbrication on the sac itself. That has been of great assistance to me in difficult sliding herniæ.

DR. E. S. JUDD, Rochester, Minnesota, read a paper (by invitation) entitled "Ulcer of the Duodenum."

DR. A. J. OCHSNER read a paper entitled "Renal Calculus in the Pelvis of a Floating Kidney with the other Kidney Absent."

DR. HARRY JACKSON read a paper entitled "The Circulation of the Cerebrospinal Fluid and Its Relation to Acute Injuries of the Brain."

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

SURGICAL complications of dysentery are not frequently encountered in this country, possibly because those types of bowel infections which usually cause complications are comparatively rare here; nevertheless the possibility should be constantly kept in mind. The average textbook records the various pathological conditions which may arise during the course of a dysentery, but the inference is that they are rare, which of necessity is true. It is, therefore, of interest to read the little volume by Cope[1] which tabulates the author's experience in the Orient in caring for many cases of bowel infections. The frequency of liver abscess with its symptomology, pathology, and treatment is the more essential portion of the work and it is worth any medical man's time and effort to read this as it freshens his memory as to the insiduous course of this condition. We are no doubt seeing more and more cases of disseminated infection, associated with multiple and deep-seated abscess formation, many of them going unrecognized and found only at autopsy. A more careful and painstaking study of the possibilities might lead to more frequent correct diagnosis.

Arthritis, as the author indicates, is not an unusual complication of a bowel infection. This in itself should cause us to consider, to a greater extent, a possible etiology for our rather numerous cases of chronic arthritis, and not to pass over the subject of the intestines in the usual superficial manner. This little volume is truly food for thought.

J. A. WOLFER.

PROBABLY no European surgeon is more respected and honored in this country than Moynihan; his surgical judgment and technique are respected by all. His enormous experience founded on an unusual intellect and brilliant mind has supplied the medical profession of the world with food for many years. Many of his addresses are unusually instructive and interesting. They incorporate his views on many subjects in a manner which is most logical and although, in some instances, he takes a most emphatic stand in opposition to many more or less adopted views, in the end one is convinced that he is right.

In answer to many requests by friends, there is at hand a little volume of essays by Moynihan.[2] It comprises a series of addresses delivered in the past few years on subjects most vital to the medical profession. For the most part these essays are a general statement of conceptions by the author. The "Murphy Memorial Oration" gives an unusual and interesting description of the history of medicine as it is marked by the great men of the past. The address on "The Diagnosis and Treatment of Gastric Ulcer" is, to the reviewer's mind, one of the most instructive articles in print today. It is most comforting to find a man who has the conviction and courage to dispute the apparently promiscuous diagnosis of gastric ulcer which is so commonly tabulated in lengthy statistics along with the very large percentage of cures by medical means. No doubt the operating surgeon has more opportunities to verify his diagnoses than the internest and in many instances he finds his patient suffering from chronic gall-bladder disease or appendicitis rather than from ulcer. The question can rightly be raised as to the value of statistics on gastric ulcer which are not the result of observation on the operating table on the living body. Truly a recovery from a series of symptoms by following a certain medical régime is not conclusive evidence that the patient must have been suffering from a pathological process that these symptoms might indicate.

This little volume contains nine essays, each a treasure. The subject matter is not given in the ordinary stereotype manner but in the author's characteristic way, and it is an unusual pleasure, even for the experienced surgeon, to read this little work.

J. A. WOLFER.

[1] SURGICAL ASPECT OF DYSENTERY INCLUDING LIVER ABSCESS. By Zachary Cope, B.A., M.D., M.S. (Lond.), F.R.C.S. (Eng.) London: Oxford University Press, 1920.

[2] ESSAYS ON SURGICAL SUBJECTS. By Sir Berkeley Moynihan, K.C.M.G., C.B. Philadelphia and London: W. B. Saunders Company, 1921.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

TWELFTH ANNUAL SESSION, BOSTON, OCTOBER 23–27, 1922

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THE HOSPITALS OF BOSTON

THE City of Boston is exceptionally well provided with hospitals. The telephone directory contains a list of 120 large and small institutions for the care of the sick. Many of these are private or semiprivate enterprises, but all are open to visits of medical men.

The following list gives the names of the larger and better known institutions, and it is hoped that every member of the College of Surgeons who comes to Boston in October will inspect most of them.

The Massachusetts General Hospital is situated in the old West End, its grounds bordering upon the Charles River Esplanade. Two years ago this hospital celebrated the one hundredth anniversary of its foundation; there is only one older hospital in the United States. The original building is of New England granite, a stately, restrained, classical structure planned by Bulfinch, the Boston architect who designed also the Massachusetts State House and University Hall, Harvard University. Under the dome of this building is the old operating theater in which was given the first public formal demonstration of complete surgical anæsthesia; the original apparatus, the operating table, the instrument cases and the various furnishings of this room remain today as they were on October 16, 1846, when Dr. John Collins Warren, after removing a tumor of the neck from a sleeping patient, said gravely to the wondering audience, "Gentlemen, this is no humbug!" This announcement, frequently misunderstood, refers to statements which had been freely made in regard to Dr. Morton and his mysterious agent in the weeks preceding this demonstration. Every physician who comes to Boston should see this room in which America's greatest contribution to medical science and practice was given to the world.

The Massachusetts General contains about 450 beds and has a very large outpatient department. The names of its surgeons and physicians, past and present, are known the world over.

The Boston City Hospital, in the South End, was opened May 1, 1864. It is one of the best municipal hospitals in the United States, and refutes the pessimistic impression that city politics and efficient hospital administration are incompatible. At present the total capacity is 1,200 beds; this includes the South Department for Contagious Diseases, a complete and separate plant in its own grounds, on the western side of Massachusetts Avenue; the Convalescent Home in Dorchester, admirably situated in spacious grounds adjoining a park and other open spaces; the Relief Station in Haymarket Square; and the East Boston Relief Station. In addition, a new surgical outpatient department is under con-

struction, which has been pronounced by visiting experts to be as good as anything in the country. The new Thorndike Laboratory will be open for inspection, and perhaps in active operation, in the latter part of October. The X-ray apparatus at present being installed is unexcelled. A great proportion of the traumatic surgery of Boston comes to the City Hospital, and the fracture clinic is enormous; henceforth, whatever the hour it enters, every fracture may be examined and reduced and put into apparatus under direct radioscopic observation.

The Peter Bent Brigham Hospital, in the newer part of Boston, on the edge of the park system and the town of Brookline, contains about 250 beds. It is one of the most recent of Boston hospitals, having been opened in 1913, and is adjacent to the Harvard Medical School. Dr. Henry A. Christian, Hersey Professor of Theory and Practice of Physic, and Dr. Harvey Cushing, Moseley Professor of Surgery in the Harvard Medical School, have been appointed by the trustees of the hospital, physician in chief and surgeon in chief respectively. This hospital is closely affiliated with the Harvard Medical School which it adjoins.

The Robert Brigham Hospital, on Parker Hill, for the care of chronic disease, is at present under the administration of the United States. The original buildings are admirable from the standpoint of hospital practice and add an architectural ornament to that portion of Boston.

The Carney Hospital, in South Boston, situated on Dorchester Heights, contains 175 beds and a large outpatient department. It is built close to the top of the hill which was fortified by General George Washington in 1775. By virtue of these fortifications the British fleet in Boston Harbor was brought under the guns of the American Army and as a result, on March 17, the British fleet departed for Halifax and did not return. This date, a happy combination of a patriotic anniversary and the birth of a favorite saint, has been celebrated enthusiastically by the entire population of South Boston for 150 years.

The Massachusetts Homeopathic Hospital on East Concord Street was founded in 1855. It is a general hospital of 550 beds which is affiliated with Boston University and situated on adjoining land. It is an excellent, well-equipped, and progressive institution.

The Collis P. Huntington Memorial Hospital, erected by the Cancer Commission of Harvard University on the grounds of the Medical School, affords clinical and laboratory facilities for the intensive study and treatment of malignant growths; it contains about 35 beds and has also an outpatient department.

The Boston Lying-In Hospital, on Blossom Street, near the Massachusetts General Hospital, has at present about 50 beds, but is soon to occupy a spacious and adequate new building on Longwood Avenue, directly opposite the Medical School. In 1920 more than a 1,000 patients were delivered in the hospital, and about 1,300 in their own homes by the hospital externes.

The Boston Dispensary, on Bennett Street, contains a well-equipped ward of 30 beds for children, but does most of its work in its outpatient department and by visits to patients' homes. One hundred and fifty thousand visits were made in 1920.

The Children's Hospital, adjoining the Medical School, possesses an admirable plant of about 250 beds. Nearly 5,000 ward patients and more than 40,000 outpatients were treated during the past year.

The Massachusetts Charitable Ear and Eye Infirmary, on Charles Street near the Massachusetts General Hospital, is one of the largest institutions of its kind in the world. It contains more than 200 beds, treats in the wards 4,500 patients, and receives 75,000 visits from outpatients each year.

The United States Naval Hospital recently extensively enlarged has a commanding situation in Chelsea overlooking the harbor. It cares for large numbers of veterans of the World War, in addition to the personnel of the navy. It has 1,200 beds.

The New England Hospital for Women and Children is pleasantly situated on spacious grounds in Roxbury. It has 175 beds, and its active staff is composed exclusively of women doctors.

The Forsyth Infirmary, a very beautiful and well-planned building in the Fenway, gives free dental service to the school children of Boston. Facio-maxillary surgery is also a specialty here.

The Cambridge Hospital located on the banks of the Charles River in Cambridge is a very well-equipped modern hospital of 175 beds.

The Free Hospital for Women, in Brookline, has about 100 beds and a large outpatient department. It is beautifully situated on the edge of the Boston park system, near Brookline village.

St. Elizabeth's Hospital, in Brighton, possesses a new and very satisfactory plant, and contains about 200 beds; its outpatient department is large and well outfitted.

Besides these, there are the Boston State Hospital of about 3,000 beds, near Franklin Park, for nervous and mental cases; the MacLean Hospital, with 200 beds, a part of the Massachusetts General Hospital, for similar cases; the Long Island Hospital, with 500 beds, in Boston Harbor, for the care of the chronic sick of the city; the Good Samaritan Hospital near the Medical School; and the Boston Psychopathic Hospital for the observation of acute, curable, incipient, and doubtful cases of mental disease.

It is obvious from the foregoing, which by no means exhausts the list, that Boston does not lack efficient hospitals. Other institutions of great interest are the Boston Medical Library and Harvard, Tufts, and Boston University Medical Schools. The Boston Medical Library, the third medical library in point of size in the United States, is situated on the Fenway in the Back Bay. All of these institutions extend a cordial welcome to the members of the College of Surgeons and their guests.

THE CLINICAL CONGRESS IN BOSTON

IN a general way the plans for the twelfth annual session to be held in Boston, October 23 to 27, conform to those of previous sessions of the Congress. Clinical demonstrations in the hospitals, laboratories, and medical schools will fill the morning and afternoon hours of each of the four days—Tuesday to Friday inclusive.

The preliminary program of clinics and demonstrations as published in the following pages gives one an excellent idea of the variety and scope of the clinical work to be demonstrated. The real program of the Congress will be bulletined at the headquarters each afternoon during the session, and will present in great detail a complete list of the operative clinics and demonstrations to be given in the several hospitals, laboratories, and schools.

The Committee on Arrangements plans to provide a program that will completely represent the clinical activities of that great medical center. All departments of surgery will be represented, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat and mouth, experimental surgery, surgical pathology, roentgenology, etc. An outstanding feature of the clinical program will be a series of special demonstrations that have been arranged in several of the hospitals in which members of the medical staff will participate.

On Monday morning at 9:30 and at 2:30 in the afternoon a conference on the problems related to the hospital standardization program of the College will be held in Jordan Hall. The program therefor is published in the following pages. A similar conference at the Philadelphia meeting in 1921 proved to be a decidedly interesting and instructive feature, and it is expected that a further discussion of these matters will add to the interest in this department of the College work. The annual approved list of hospitals which, on inspection, fulfill the requirements of the minimum standard of the College will be released on this day.

The presidential meeting—the first formal session of the Congress—will be held on Monday evening in Symphony Hall. Dr. Harvey Cushing will be inaugurated as President and will deliver his inaugural address. The retiring president, Dr. John B. Deaver, will review briefly the work of the past year. Professor Raffaele Bastianelli of Rome, Italy, will deliver the John B. Murphy Oration in Surgery, his subject being "Surgery of the Joints." At this meeting the distinguished foreign guests will be presented.

Tuesday and Thursday evenings will be devoted to scientific sessions in Jordan Hall at which a series of interesting papers dealing with surgical subjects of present-day importance will be presented by eminent American and European surgeons. In the same hall on Wednesday evening Fellows of the College and their ladies will be guests of the Boston Surgical Society at a special meeting, the occasion being the presentation of the Henry Jacob Bigelow medal to Dr. William Williams Keen of Philadelphia.

The tenth convocation of the American College of Surgeons will take place on Friday evening in Symphony Hall at which time Fellowship in the College will be conferred upon a group of American and Canadian surgeons and honorary Fellowships upon a number of the distinguished guests. The Fellowship Address will be delivered by Professor Raffaele Bastianelli. The complete program for all of the evening sessions will be found in the following pages.

The following distinguished Latin-American surgeons are expected to attend the Clinical Congress: Dr. José E. Casuso, Dr. José A. Presno, and Dr. Rafael Menocal of Havana, Cuba; Dr. Gabriel M. Malda and Dr. Ulises Valdes of Mexico; Dr. José Arce of Buenos Aires, Argentina; Dr. Claudio J. Sanjines of La Paz,

Bolivia; Dr. Olympio da Fonseca of Rio de Janeiro, Brazil; Dr. Gregorio Amunotegui and Dr. Lucas Sierra of Santiago, Chile; Surgeon-General Alberto Adriasola and Dr. Guillermo E. Muennich of Valparaiso, Chile; Dr. Pompilio Martinez of Bogotá, Colombia; Dr. Francisco Graña of Lima, Peru; Dr. Enrique Pouey of Montevideo, Uruguay; and Dr. Louis Razetti of Caracas, Venezuela.

HEADQUARTERS

General headquarters for the Congress will be at the Copley Plaza Hotel, which is centrally located in the Back Bay district. The large ballroom of the hotel, foyers adjacent thereto, with other large rooms on the main floor, have been reserved for the use of the Congress, affording ample space for registration and ticket bureaus, bulletin rooms, etc.

Headquarters will be open for registration at 12 M. Monday, October 23. The clinical program for Tuesday will be bulletined during the afternoon, and tickets for Tuesday's clinics will be issued as visiting surgeons register.

REDUCED RAILWAY FARES

The railways of the United States and Canada with but few exceptions have authorized the sale of round-trip tickets to Boston on account of the Clinical Congress at one and one-half the ordinary one-way fare, provided that the journey be made by the same route in both directions. Round-trip tickets at the reduced rate will be sold to members only upon presentation of identification certificates issued from the office of the Director-General. Such identification certificates will be issued to all who register in advance, one certificate being sufficient for the individual surgeon and dependent members of his family. Under this arrangement round-trip tickets will be sold from October 19 to 25 in the central and eastern states, and eastern Canada, with a final return limit of November 2.

In the far western states and the western provinces of Canada the earliest selling date is October 18, with a return limit of November 3.

The reduction in fares does not apply to Pullman fares or to excess fares charged for passage on certain trains. Local railway ticket agents will supply detailed information with regard to rates, routes, etc.

SPECIAL TRAIN FROM CHICAGO TO BOSTON

For the convenience of members from the West who will attend the meeting in Boston, the New York Central Railroad will undertake to provide a special train leaving Chicago at 9:15 a.m., Sunday, October 22, arriving in Boston at 10 a.m., Monday. This special train will duplicate the equipment of the "Twentieth Century," including standard Pullman sleeping, compartment, club, observation, and dining cars. No extra fare will be charged for passage on the special train, and members are urged to make their reservations therefor at the earliest possible date. This arrangement is contingent upon reservations for such special train being made by the minimum number required by the Interstate Commerce Commission rules.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting attendance to a number that can be comfortably accommodated. The limit of attendance is based upon the result of a survey of the amphitheaters, lecture rooms, and laboratories of the several hospitals and medical schools as to their capacity for accommodating visitors. This plan requires registration in advance on the part of all who expect to attend, and when the limit of attendance has been reached through such advance registration at the office of the College, no further applications will be accepted. This plan insures accommodations at the clinics for all who register in advance, and the necessity for adopting such a plan will be apparent to all. There has been a very large advance registration, and it is probable that the limit of attendance will be reached some weeks in advance of the meeting.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets. This has proven an efficient means of providing for the distribution of the visiting surgeons among the several clinics, and insures against overcrowding. The number of tickets issued for any clinic is limited to the capacity of the room in which that clinic is to be given. Tickets are issued at headquarters each morning at 8 o'clock.

Each afternoon during the session, a complete program of the following day's clinics will be posted on bulletin boards at headquarters. After the program has been so posted, reservations for tickets for the next day's clinics may be filed, the clinic tickets to be issued the following morning at 8 o'clock. A printed program will be issued each morning which will contain the complete clinical program for the day, with announcements of evening sessions and other information.

REGISTRATION FEE

Plans for the Congress provide that no financial burden may be imposed upon the members of the profession in the city entertaining the Congress. Hence a registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, such fees providing the funds from which to meet the expenses of conducting the meeting. To each surgeon on registering in advance is issued a formal receipt for the registration fee, which receipt is to be exchanged for a general admission card upon his registration at headquarters in Boston. This card, which is non-transferable, must be presented to secure special clinic tickets and for admission to the evening meetings.

HOTEL ACCOMMODATIONS

The Committee on Arrangements has appointed a Committee on Hotels, with Dr. Stephen Rushmore as chairman, to aid Fellows in securing hotel accommodations during the Boston meeting. Boston has ample hotel facilities, many first-class hotels being located within walking distance of headquarters. Fellows are requested to make their applications for accommodations direct to the hotels named in the list recommended by the Committee as printed below. If difficulty is experienced in securing satisfactory accommodations the matter should be taken up with Dr. Rushmore, 520 Commonwealth Avenue, Boston.

BOSTON HOTELS WITH RATES

	Single Room		Double Room	
	With Bath	Without	With Bath	Without
Adams House, 553 Washington St			6.00– 7.00	3.50–4.50
American House, 56 Hanover St			6.00	4.00
Arlington, 18 Chandler St	2.50–3.00		4.00– 5.00	
Avery, 24 Avery St			6.00	
Bellevue, 21 Beacon St			8.00–10.00	4.00–6.00
Brewster, 19 Boylston St	3.00–4.00	2.50–3.00	5.00– 7.00	
Brunswick, Boylston and Clarendon	4.00	3.00	6.00– 7.00	5.00
Buckminster, 641 Beacon St	3.00	2.50	6.00	5.00
Commonwealth, Bowdoin St			5.00	
Copley Plaza, Copley Square	6.00		11.00	
Copley Square, 40 Huntington Ave	4.00		6.00	
Essex, 693 Atlantic Ave	5.00	3.00–3.50	7.00– 8.00	
Fritz-Carleton, 1138 Boylston St		3.00	8.00–10.00	4.50
Garrison Hall, 8 Garrison St	3.00		5.00	
Langham, 1699 Washington St	3.00	2.00	4.00	3.00
Lenox, Exeter and Boylston	5.00	3.50	8.00	5.00
Parker House, School and Tremont	5.50–7.00	4.00–4.50	5.50– 7.00	5.00
Plaza, 419 Columbus Ave			5.00	3.00
Priscilla (women only), 307 Huntington Ave	3.00		4.50– 6.00	
Puritan, 390 Commonwealth Ave	5.00	2.50	6.00	
Putnam, 284 Huntington Ave		2.00–3.00		3.00–4.00
Quincy, 47 Brattle St	3.50	2.00–2.50	6.00– 7.00	3.50–4.00
Ranelegh, 11 Mountfort St			5.00	
Somerset, Commonwealth and Charlesgate			10.00	5.00
Stewart Club (women only), 102 Fenway		3.50		6.00
United States, 90 Beach St		2.50		4.00
Vendome (American plan), Commonwealth and Dartmouth	8.00		14.00–16.00	
Victoria, 271 Dartmouth St	4.00	3.00	6.00	5.00
Westminster, Copley Square	4.00	2.50	7.00	3.50
Young's Court and City Hall			7.00– 8.00	4.50–5.00

PROGRAM FOR EVENING MEETINGS

Presidential Meeting, Monday, October 23—Symphony Hall, 8 P.M.

Address of Welcome: LINCOLN DAVIS, M.D., Boston, Chairman of Committee on Arrangements.

Address of the retiring president: JOHN B. DEAVER, M.D., Philadelphia.

Introduction of foreign guests: RAFFAELE BASTIANELLI, M.D., F.R.C.S. (Hon.), Rome; FRANCIS SEYMOUR KIDD, M.Ch., F.R.C.S., London; ANDREW FULLERTON, C.B., C.M.G., Belfast; EINAR KEY, M.D., Stockholm.

Inaugural Address: HARVEY CUSHING, M.D., Boston

The Doctor John B. Murphy Oration in Surgery—"Surgery of the Joints": RAFFAELE BASTIANELLI, M.D., F.R.C.S. (Hon.), Rome.

Tuesday, October 24—Jordan Hall, 8 P.M.

EINAR KEY, M.D., Stockholm: Treatment by Embolectomy of Circulatory Disturbances in the Extremities Due to Emboli.

SYMPOSIUM: Genito-Urinary Surgery.

HUGH H. YOUNG, M.D., Baltimore: Prostatectomy—Preparatory, Operative, and Postoperative Methods.

FRANCIS SEYMOUR KIDD, M.Ch., F.R.C.S., London: Simple Mesodermal Tumors of the Urinary Bladder; with the Report of a Case Treated by Operation.

ANDREW FULLERTON, C.B., C.M.G., Belfast: A Note on Unilateral Diuresis.

J. BENTLEY SQUIER, M.D., New York: The Surgery of Vesical Neoplasms.

Discussion: WILLIAM C. QUINBY, M.D., Boston; ALEXANDER RANDALL, M.D., Philadelphia; JOHN T. GERAGHTY, M.D., Baltimore; JOHN H. CUNNINGHAM, M.D., Boston.

Wednesday, October 25—Jordan Hall, 8:30 P.M.

SPECIAL MEETING OF THE BOSTON SURGICAL SOCIETY

Introductory Remarks: ROBERT W. LOVETT, M.D., Boston, President.

Presentation of Henry J. Bigelow Medal to WILLIAM WILLIAMS KEEN, M.D., Philadelphia.

"Sixty Years Ago—1862 to 1922": WILLIAM WILLIAMS KEEN, M.D., Philadelphia.

Thursday, October 26—Jordan Hall, 8 P.M.

SYMPOSIUM: Carcinoma of the Jaws, Tongue, and Cheeks and Lips.

GEORGE W. CRILE, M.D., Cleveland: General Principles Involved in Operations; Summary of Results Obtained in the Crile Clinic, with Special Reference to Treatment of Carcinoma of the Jaws.

EDWARD S. JUDD, M.D., Rochester, Minn.: Summary of Results Obtained in the Mayo Clinic, with Special Reference to Treatment of Cancer of the Tongue.

GEORGE E. BREWER, M.D., New York: Summary of Results Obtained in the Presbyterian, Memorial, and Roosevelt Hospitals of New York, with Special Reference to Treatment of Cancer of the Cheeks and Lips.

Discussion: ROBERT B. GREENOUGH, M.D., Boston; ALBERT J. OCHSNER, M.D., Chicago; VILRAY P. BLAIR, M.D., St. Louis; JOSEPH C. BLOODGOOD, M.D., Baltimore; DOUGLAS QUICK, M.D., New York; GEORGE P. MULLER, M.D., Philadelphia; HARVEY R. GAYLORD, M.D., Buffalo; ALEXANDER E. GARROW, M.D., Montreal; CHANNING C. SIMMONS, M.D., Boston.

Friday, October 27—Symphony Hall, 8 P.M.

CONVOCATION OF THE AMERICAN COLLEGE OF SURGEONS

Invocation: REVEREND DOCTOR ALEXANDER MANN, Boston.

Conferring of Honorary Fellowships.

Presentation of Candidates for Fellowship.

Presidential Address: HARVEY CUSHING, M.D., Boston.

Fellowship Address: RAFFAELE BASTIANELLI, M.D., F.R.C.S. (Hon.), Rome.

HOSPITAL CONFERENCE

MONDAY, OCTOBER 23, IN JORDAN HALL

Morning Session, 9:30 to 12:30

JOHN B. DEAVER, M.D., F.A.C.S., President, Presiding

Report on the Standardization Activities of the College in 1922
FRANKLIN H. MARTIN, M.D., F.A.C.S., Director-General, American College of Surgeons

The Doctor and the Hospital
FREDERIC A. WASHBURN, M.D., Superintendent, Massachusetts General Hospital, Boston

The Minimum Standard and Its Application to Hospitals
FREDERICK W. SLOBE, M.D., Hospital Standardization Department, American College of Surgeons

What Real and Lasting Benefit Has Come to the Patient from Hospital Standardization?
CHARLES B. MOULINIER, S.J., President, Catholic Hospital Association

The American Hospital
A. R. WARNER, M.D., Executive Secretary, American Hospital Association

Hospital Standardization from a Public Health Standpoint
D. A. CRAIG, M.D., Provincial Commissioner, Nova Scotia Division, Canadian Red Cross, Halifax, Nova Scotia

Hospital Standardization from the Viewpoint of the Medical Staff
R. A. HUGHES, M.D., Moncton, New Brunswick

Side-lights on Hospital Standardization
ROBERT JOLLY, Superintendent, Baptist Hospital, Houston, Texas

The Analysis of End-Results
EUGENE H. POOL, M.D., F.A.C.S., New York, and E. A. CODMAN, M.D., F.A.C.S., Boston

General Summary of Hospital Standardization
MALCOLM T. MACEACHERN, M.D., C.M., Director-General, Victorian Order of Nurses for Canada

Afternoon Session, 2 to 4:30—General Round Table Discussion

Conducted by MALCOLM T. MACEACHERN, M.D., C.M.

The Round Table Discussion will be confined largely to the requirements of the Minimum Standard. Hospital superintendents, staff members, and members of boards of trustees are urged to send in questions which they desire to be answered, in order that the discussion may shed light on the various difficulties encountered. After representative speakers have opened the discussion of these questions, the subsequent discussion will be open to all. A tentative list of the topics to be considered follows:

I. Staff Organization:
   1. The selection of the exact type of staff organization best suited to local needs.
   2. The division of responsibility into representative committees.
   3. The initial organization of the staff conference.
   4. The agenda and detailed description of the staff conference.
   5. Methods of stimulating interest and enthusiasm in staff conferences.
   6. Monthly analysis of hospital work.

II. Case Records:
   1. The component parts of a case record.
   2. Methods of securing the records.
   3. Methods of stimulating increased interest in the records.
   4. The hospital historian or record-clerk.
   5. Filing systems, card indices, disease nomenclatures, and follow-up systems.

III. Laboratories and X-ray facilities:
   1. Methods of stimulating increased use of laboratories by the medical staff.
   2. Relationship of laboratory charges to laboratory service, and the various systems of laboratory charges commonly employed.
   3. The extent to which routine laboratory examinations should be employed.
   4. Laboratory facilities in the small hospital.
   5. Laboratory reports and filing systems.
   6. What should constitute the complete service in an X-ray department?
   7. The interpretation of X-ray plates by roentgenologist versus interpretation by individual physicians.
   8. To what extent can X-ray facilities outside of the hospital be used satisfactorily?

IV. Miscellaneous:
   1. What points in particular should the hospital surveyor investigate in making his annual visit?
   2. Making the public understand the value of hospital standardization.
   3. Methods of increasing the efficiency of the hospital survey of the College.

It should be clearly understood that all are urged to take part in the Round Table. Including the speakers of the morning program, the following names are a partial list of those who have been invited to lead in the discussion:

John G. Bowman, Chancellor, Pittsburgh University, Pittsburgh

Pliny O. Clark, President, Protestant Hospital Association
H. E. Webster, Superintendent, Royal Victoria Hospital, Montreal
W. C. Rappleye, Rockefeller Foundation
Horace G. Wetherill, M.D., F.A.C.S., Denver
Brigadier General C. E. Sawyer, M.C., U.S.A.
Joseph B. Howland, M.D., Superintendent, Peter Bent Brigham Hospital, Boston
George W. Swift, M.D., F.A.C.S., Seattle
E. T. Dillon, M.D., F.A.C.S., Los Angeles
Roy C. Kingswood, M.D., London, Ontario
Rev. Newton E. Davis, Executive Secretary, Conference Board of Hospitals and Homes of Methodist Church
Matthew O. Foley, Managing Editor, Hospital Management, Chicago
S. S. Goldwater, M.D., Superintendent, Mt. Sinai Hospital, New York City
Joseph J. Weber, Editor Modern Hospital, Chicago
Frank E. Chapman, Superintendent, Mt. Sinai Hospital, Cleveland
Henry M. Pollock, M.D., Superintendent, Massachusetts Homeopathic Hospital, Boston
R. M. Harbin, M.D., F.A.C.S., Rome, Georgia
Charles A. Gordon, M.D., F.A.C.S., Brooklyn
John M. Baldy, M.D., F.A.C.S., Philadelphia
A. K. Haywood, M.D., Superintendent, Montreal General Hospital, Montreal

PRELIMINARY CLINICAL PROGRAM FOR BOSTON MEETING

MASSACHUSETTS GENERAL HOSPITAL

Tuesday, October 24

C. A. Porter, G. W. W. Brewster, R. B. Greenough, Hugh Williams, and associates—9. General surgical operations.

Surgical Staff Clinic—2.

C. A. Porter, J. H. Means, E. P. Richardson, and G. W. Holmes—Surgery of the thyroid gland.
T. W. Harmer—Tendon surgery.
Chester Jones—Bile analysis.
D. F. Jones—Pancreatitis.
W. J. Mixter, J. B. Ayer, and John S. Hodgson—Neurological surgery.
C. L. Scudder and H. F. Hewes—Chronic gastric ulcer.
Beth Vincent—Plastic surgery.
Wyman Whittemore—Surgery of the lung.

Wednesday, October 25

Orthopedic Operations and Demonstrations—9.

Smith Peterson—Arthrodesis of sacro-iliac joint.
M. H. Rogers—Arthrodesis of hip joint.
Z. B. Adams—Reduction of congenital dislocation of the hip.
R. B. Osgood—Excision of semilunar cartilage or excision of knee joint.
P. D. Wilson—Syme amputation.
L. T. Brown—Spinal fusion.
R. N. Hatt—Stoeffel operation for spastic paraplegia.
Z. B. Adams—Keller's operation for hallux valgus.

Demonstration of Orthopedic Cases—2.

P. D. Wilson—Results of Syme amputation, apparatus.
R. B. Osgood—Multiple myeloma; report of cases with pathological specimens.
E. G. Brackett—Orthopedic surgery in China.
Smith Peterson—Correction of deformities of the hip by arthrodesis, results.
Mark H. Rogers—Results of treatment of intractable sciatica by arthrodesis of the sacro-iliac joint.
Z. B. Adams—Possibility of reducing congenital dislocation of the hips in children over seven.
L. T. Brown—Results of operative treatment of tuberculosis of the spine in adults.
J. E. Goldthwaite—Physical development in military training camps.

Thursday, October 26

D. F. Jones, Lincoln Davis, E. P. Richardson, and associates—9. General surgical operations.

Staff Clinic: Symposium on Malignant Diseases—2.

R. B. Greenough—Malignant disease, introductory remarks.
D. F. Jones—Cancer of the rectum.
R. B. Greenough—Cancer of the breast.
D. C. Green—Cancer of the antrum.
Lincoln Davis and G. A. Leland—Cancer of the uterus.
Channing Simmons—Osteogenetic sarcoma.
G. W. Holmes—X-ray as a prophylactic and in palliative treatment.
H. P. Mosher—Cancer of the œsophagus.
C. L. Scudder and H. F. Hewes—Cancer of the stomach.

Friday, October 27

R. B. Greenough and D. F. Jones—9. General surgical operations.
J. D. Barney and associates—11. Genito-urinary operations.

Surgical Clinic by Staff—2.

J. D. Barney—Pneumopyelography as an aid in diagnosis.
G. G. Smith—Treatment of cancer of the penis.
R. F. O'Neil.
E. G. Crabtree—Surgical approach of the lower end of the ureter.
H. H. Crabtree—Experiences with stone in the lower ureter.
G. G. Jones—Methods of demonstrating tubercle bacilli in the urine.
D. F. Jones and associates—3:45. Standardized treatment of fractures.

BOSTON CITY HOSPITAL

Tuesday, October 24

F. B. Lund—9. General surgical operations.
E. B. Young—9. Gynecological operations.
J. C. Hubbard and associates—2. Dry clinic (general surgery).
O. J. Herman—2. Intestinal gunshot wounds.
E. B. Young and associates—2. Series and results in miscarriages.

G. L. VOGEL and associates—2. Ear and throat cases.
L. M. FREEDMAN—2. Carcinoma of soft palate and larynx.
E. J. MONOHAN—2. Tonsillectomy in acute disease.

Wednesday, October 25

J. C. HUBBARD and associates—9. General surgical operations.
G. L. VOGEL and associates—9. Ear and throat operations.
F. B. LUND—2. Demonstrations: carcinoma of stomach; carcinoma of tongue; facial nerve anastomosis; results of operation.
I. J. WALKER—2. Echinococcus cyst of liver; resection of stomach, three cases; oral cancer, radium, three cases.
STEPHEN B. MALLETT and W. H. CANAVAN—2. Cases of dental surgery.

Thursday, October 26

H. A. LOTHROP and associates—9. General surgical operations.
PAUL THORNDIKE and associates—9. Genito-urinary operations.
F. J. COTTON and associates—2. Demonstrations: operation for recurrent dislocation of shoulder; series of cases of artificial ligaments in loose knees; arthroplasty, Putti technique; operation for flat-foot, new technique; pelvic fracture cases; Colles fracture results.
P. F. BUTLER and A. W. GEORGE—2. Surgical X-rays.

Friday, October 27

F. J. COTTON and associates—9. General surgical operations.
H. A. LOTHROP and associates—2. Demonstration of surgical cases.
HORACE BINNEY—2. Gangrene of the lung; abscess of the lung; separation of the lower epiphysis of the femur; certain type of fracture of the forearm.
A. R. KEMPTON—2. Tumor of carotid body.
H. B. STEVENS and associates—2. Ophthalmic surgery.
J. J. CORBETT—2. Series of cataract operations.

CHILDREN'S HOSPITAL

Tuesday, October 24

R. W. LOVETT and associates—9. Orthopedic operations.

Surgical Staff Clinic—9.

W. E. LADD—Harelip cases (with lantern slides).
C. G. MIXTER—Undescended testicle.
J. S. STONE—Pneumoccocus peritonitis; omental tumors.
G. D. CUTLER—Teratoma; webbed fingers.
T. H. LANMAN—Hæmangiomata.
J. S. STONE and associates—2. General surgical operations.

Orthopedic Staff Clinic—2.

ROBERT SOUTTER—Obstetrical paralysis.
A. T. LEGG—Pathology and treatment.
J. W. SEVER.
J. H. FITZSIMMONS—Clubfoot.
R. F. OBER—Treatment and operative means.

Wednesday, October 25

A. R. LOVETT and associates—9. Orthopedic Clinic: Fractures of the spine in industrial accidents; results of stabilizing operations for weak or frail joints in poliomyelitis.
F. R. BLUMENTHAL—9. Cases of orthodontia.
J. S. STONE and associates—9. General surgical operations.
R. W. LOVETT and associates—2. Orthopedic operations.

Surgical Staff Clinic—2.

BRONSON CROTHERS—Injuries of spinal cord in childbirth.
GEORGE D. CUTLER—Meningocele.
JAMES S. STONE—Spina bifida occulta.
WILLIAM E. LADD—Megacolon.
CHARLES G. MIXTER—Congenital defect of bile ducts.

Thursday, October 26

R. W. LOVETT and associates—9. Orthopedic operations.

Surgical Staff Clinic—9.

T. H. LANMAN—9. Skin grafts.
W. E. LADD—9. Cases of plastic surgery.
G. D. CUTLER—9. Ruptured kidney.
C. G. MIXTER—9. Tumors of the kidney; chronic pyelitis.
JAMES S. STONE and OSCAR M. SCHLOSS—9. Pyloric stenosis and spasm.
D. CROSBY GREENE—9. Cases of laryngeal and œsophageal stricture.
J. S. STONE and associates—2. General surgical operations.
R. W. LOVETT and associates—2. Orthopedic clinic: Congenital dislocations of hip, results of operative treatment; Legg-Calvé disease, pathology and treatment; relief of contracture of the hip.

Friday, October 27

J. S. STONE and associates—9. General surgical operations.
R. W. LOVETT and associates—9. Orthopedic clinic: Infantile paralysis, results in treatment clinic; muscle and tendon transplantation, the result of treatment; transplantations of the tensor fasciæ femoris for paralysis of the abductors.
R. W. LOVETT and associates—2. Orthopedic operations.

Surgical Staff Clinic—2.

W. E. LADD—Intussusception.
C. G. MIXTER—Intestinal obstruction.
G. D. CUTLER—Intestinal obstruction by Meckel's diverticulum.
J. S. STONE and O. M. SCHLOSS—Atypical cases of appendicitis in children; differential diagnosis.

MASSACHUSETTS HOMEOPATHIC HOSPITAL

Tuesday, October 24

J. EMMONS BRIGGS and W. S. K. THOMAS—9. Surgery of the stomach, operations.
D. W. WELLS and associates—9. Operations on the eye.
A. G. HOWARD—9. Orthopedics.
CONRAD SMITH—9. Nose and throat clinic.
D. W. WELLS—9. Eye clinic.
S. W. ELLSWORTH—9. Lesions of the gastro-intestinal tract.
C. T. HOWARD and W. S. K. THOMAS—2. General surgical operations.
A. W. ROWE and W. L. MENDENHALL—2. Vital function tests in relation to surgery.

Wednesday, October 25

T. E. CHANDLER and H. J. LEE—9. Gynecological operations.
CONRAD SMITH, E. R. JOHNSON, and C. W. BUSH—9. Nose and throat operations.
A. G. HOWARD—9. Demonstration: back strain.
T. E. CHANDLER and H. J. LEE—2. Gynecological operations.
A. S. BEGG and F. H. PRATT—2. Anatomical and physiological demonstrations.

Thursday, October 26

C. T. HOWARD and CLARENCE CRANE—9. Surgery of the biliary tract.
F. W. COLBURN and H. L. BABCOCK—9. Operations on the ear.
A. G. HOWARD—9. Orthopedics.
CONRAD SMITH—9. Nose and throat clinic.
S. W. ELLSWORTH—9. Demonstration: Some points in differential diagnosis of diseases of bones.
J. EMMONS BRIGGS and CLARENCE CRANE—2. General surgery; operative clinic.
W. H. WATTERS—2. Clinico-pathological conference and medico-legal autopsy.
D. L. BELDING—2. Wassermann test in surgical diagnosis.
S. B. HOOKER—2. The necessity for adequate compatibility tests preliminary to blood transfusion.
HELMUTH ULRICH—2. Blood tests in surgery.

Friday, October 27

A. G. HOWARD—9. Orthopedic operations.
D. W. WELLS—9. Eye clinic.
R. C. WIGGIN—2. Genito-urinary surgery; operative clinic.

FREE HOSPITAL FOR WOMEN

Tuesday, October 24

W. P. GRAVES, F. A. PEMBERTON, and R. G. WADSWORTH—9. Gynecological operations.

Wednesday, October 25

W. P. GRAVES, and F. A. PEMBERTON—9. Gynecological operations.
W. P. GRAVES—2. Clinic on procidentia; radium and cancer of the uterus.

Thursday, October 26

W. P. GRAVES, F. A. PEMBERTON, and H. W. BAKER—9. Gynecological operations.
F. A. PEMBERTON—2. Clinic on diseases of the female urethra.

CARNEY HOSPITAL

Tuesday, October 24

H. L. JOHNSON and L. E. PHANEUF—9. Gynecological operations.
L. E. PHANEUF—2. Gynecological clinic.

Wednesday, October 25

J. T. BOTTOMLEY, D. F. MAHONEY, and A. McK. FRASER—9. General surgical operations.
C. M. PROCTOR—2. Oral surgery.
W. E. BROWNE—2. End-results and demonstration of traumatic hands.

Thursday, October 26

W. R. MACAUSLAND and A. R. MACAUSLAND—9. Orthopedic operations.
W. R. MACAUSLAND and A. R. MACAUSLAND—2. Orthopedic demonstrations.

Friday, October 27

J. T. BOTTOMLEY, D. F. MAHONEY, and A. McK. FRASER—9. General surgical operations.
D. J. HURLEY and T. J. SHANAHAN—2. Eye, nose, and throat operations.

PETER BENT BRIGHAM HOSPITAL

Tuesday, October 24

HARVEY CUSHING, W. C. QUINBY, DAVID CHEEVER, JOHN HOMANS, and E. C. CUTLER—9. General surgical operations.
DAVID CHEEVER, JOHN HOMANS, E. C. CUTLER, and F. C. NEWTON—2. Clinical demonstrations and talks (general surgical cases).

Wednesday, October 25

HARVEY CUSHING, W. C. QUINBY, DAVID CHEEVER, JOHN HOMANS, and E. C. CUTLER—9. General surgical operations.
HARVEY CUSHING, GILBERT HORRAX, and PERCIVAL BAILEY—2. Clinical demonstrations in neurological surgery.

Thursday, October 26

HARVEY CUSHING, W. C. QUINBY, DAVID CHEEVER, JOHN HOMANS, and E. C. CUTLER—9. General surgical operations.
W. C. QUINBY, ROGER GRAVES, and J. J. JOELSON—2. Clinical demonstrations in genito-urinary surgery.

Friday, October 27

HARVEY CUSHING, W. C. QUINBY, DAVID CHEEVER, JOHN HOMANS, and E. C. CUTLER—9. General surgical operations.

ST. ELIZABETH'S HOSPITAL

Tuesday, October 24

ARTHUR CHUTE—9. Genito-urinary operations.
ARTHUR CROSBIE—9. Genito-urinary operations.

Wednesday, October 25

JOSEPH STANTON and HENRY ROWEN—9. General surgical operations.
GEORGE KEENAN and FRANCIS JANTZEN—9. General surgical operations.

Thursday, October 26

JOSEPH STANTON and HENRY ROWEN—9. General surgical operations.
GEORGE KEENAN and FRANCIS JANTZEN—9. General surgical operations.

Friday, October 27

THOMAS BRODERICK—9. Orthopedic operations.
CHARLES KICKHAM—9. Gynecological operations and obstetrical ward visit.

BOSTON LYING-IN HOSPITAL

Tuesday, October 24

R. S. EUSTIS—2. Hæmorrhagic disease of the newborn.
DONALD MUNRO—2. Intracranial hæmorrhage in the newborn.

Wednesday, October 25

F. S. NEWELL—2. Cæsarean section under local anæsthesia.
F. C. IRVING—2. Abdominal abortion with sterilization.
B. E. HAMILTON—2. Cardiac complications of pregnancy.

Thursday, October 26

F. S. NEWELL—9. Cæsarean section.

BOSTON DISPENSARY

Tuesday, October 24

JOHN D. ADAMS and associates—9. Orthopedic operations: Hibbs operation, tuberculosis of spine; claw foot; rigid flat-foot.

Staff Clinic in Out-Patient Department—9.

H. F. DAY and associates—General surgical cases.
MAYNARD LADD and associates—Pediatrics.
MALCOLM STORER and associates—Gynecology.
W. E. CHENERY and H. J. INGLIS—Nose and throat clinic.
JOHN D. ADAMS and associates—Orthopedic clinic.
T. C. HILL and F. P. WILLIAMS—Diseases of the rectum.
A. H. CROSBIE and associates—Genito-urinary cases.
H. F. PERRY and associates—Diseases of the skin.
J. D. ADAMS and associates—2. End-results, tuberculosis of spine, claw foot; non-operative treatment of acute hip infection. Occupational therapy (with lantern slides).

Wednesday, October 25

H. F. DAY and associates—9. Surgical operations: Inguinal hernia in the child; ingrowing toe nail; septic hand, an industrial injury.
F. P. WILLIAMS, T. C. HILL, and associates—9. Fissure in ano; internal hæmorrhoids.

Staff Clinic in Out-Patient Department—9.

H. F. DAY and associates—General surgery.
MAYNARD LADD and associates—Pediatrics.
MALCOLM STORER and associates—Gynecology.
W. E. CHENERY and H. J. INGLIS—Nose and throat clinic.
JOHN D. ADAMS and associates—Orthopedics.
T. C. HILL and F. P. WILLIAMS—Diseases of the rectum.
A. H. CROSBIE and associates—Genito-urinary clinic.
H. F. PERRY and associates—Diseases of the skin.

Staff Clinic and Short Talks—2.

BENJAMIN TENNEY—Some points in the anatomy and surgery of the knee joint.
W. P. COUES—Bone syphilis.
R. H. GILPATRICK—Ankylosis of the jaw.
W. F. TEMPLE—Out-patient anæsthesia.
F. G. BARNUM—Osteomyelitis.
T. C. HILL—Out-patient treatment of rectal diseases.
OLIVER G. TINKHAM—Fracture of the elbow joint.
CARL BEARSE—Adaptation of amputation stumps to artificial limbs.
J. J. LYNCH, JR.—Cervical adenitis.
JOHN J. MURPHY—Abdominal diagnosis in the out-patient department.
H. F. DAY—Peritonitis following tonsillar infection.

Thursday, October 26

W. E. CHENERY and H. J. INGLIS—9. Nose and throat operations.
H. J. INGLIS—9. X-ray diagnosis of diseases of nasal sinuses.

Staff Clinic in Out-Patient Department—9.

H. F. DAY and associates—General surgery.
MAYNARD LADD and associates—Pediatrics.
MALCOLM STORER and associates—Gynecology.
W. E. CHENERY and H. L. INGLIS—Nose and throat clinic.
T. C. HILL and F. P. WILLIAMS—Diseases of the rectum.
A. H. CROSBIE and associates—Genito-urinary clinic.
H. F. PERRY and associates—Diseases of the skin.

Clinic by Staff—2.

W. E. PREBLE—Postoperative care of patients.
HERMAN OSGOOD—X-ray treatment.
A. K. PAINE—Treatment of gonorrhœa in women.
L. H. SPOONER—Health clinic.
MAYNARD LADD and HILBERT F. DAY—Pyloric stenosis in infants; medical and surgical aspects.

Friday, October 27

Staff Clinic in Out-Patient Department—9.

H. F. DAY and associates—General surgery.
MAYNARD LADD and associates—Pediatrics.
MALCOLM STORER and associates—Gynecology.
W. E. CHENERY and H. J. INGLIS—Nose and throat.
J. D. ADAMS and associates—Orthopedic clinic.
T. C. HILL and F. P. WILLIAMS—Diseases of the rectum.
A. H. CROSBIE and associates—Genito-urinary clinic.
H. F. PERRY and associates—Diseases of the skin.
H. F. PERRY and associates—2. Accidents and complications in treatment of syphilis; bone syphilis; epithelioma of the skin and its treatment by radium; carbon dioxide snow as a therapeutic agent.

LONG ISLAND HOSPITAL

Wednesday, October 25

JOHN H. CUNNINGHAM and associates—9:30. Genito-urinary operations.
JOHN H. CUNNINGHAM and associates—2. Demonstration of genito-urinary cases.

Friday, October 27

JOHN H. CUNNINGHAM and associates—9:30. General surgical operations.

MASSACHUSETTS CHARITABLE EYE AND EAR INFIRMARY

Tuesday, October 24

E. A. CROCKETT and associates—9. Ear operations.
D. CROSBY GREENE, H. A. BARNES, and associates—9. Nose and throat operations.
G. S. DERBY—9. Eye operations; ward visit; out-patient clinic.
F. H. VERHOEFF—9. Lantern slide demonstration of pathological specimens.

Wednesday, October 25

D. H. WALKER and assistants—9. Ear operations.
F. E. GARLAND and assistants—9. Nose and throat operations.
W. B. LANCASTER, G. H. RYDER, and G. S. DERBY—9. Eye operations; clinical demonstrations; ward visit; out-patient clinic.
A. F. MACMILLAN—2. Demonstration of X-rays of mastoids and accessory sinuses.
H. P. CAHILL—2. Demonstration of normal histological and pathological sections especially of the internal ear.
STAFF—2. Demonstration of clinical cases.

Thursday, October 26

W. F. KNOWLES and assistants—9. Ear operations.
C. B. FAUNCE, JR.—9. Nose and throat operations.
F. H. VERHOEFF and S. J. MCDONALD—9. Eye operations; ward visit; out-patient clinic.
H. P. MOSHER, H. A. BARNES, and D. C. GREENE—2. Demonstrations: End-results of tear-sac operations; end-results of operation in cases of malignant disease of the accessory sinuses; a talk on the use of radium; end-results of cancer of the larynx.
L. E. WHITE—2. End-results of operations on the sphenoidal sinus.
F. E. GARLAND and V. H. KAZANJIAN—2. End-results in cases of nasal deformity.

H. P. Mosher, D. C. Greene, and D. C. Smith—2. Foreign bodies in the bronchus.

Friday, October 27

Philip Hammond and assistants—9. Ear operations.
H. P. Mosher and assistants—9. Throat operations.
F. H. Verhoeff and W. B. Lancaster—9. Eye operations; ward visits; out-patient clinic.
E. A. Crockett—2. Demonstration of cases showing end-results of brain abscess and meningitis.
Philip Hammond, H. P. Mosher, and D. C. Smith—2. End results in cases of radical mastoid operations.
G. L. Tober—2. End-results of operation for sinus thrombosis.

NEW ENGLAND DEACONESS HOSPITAL

Tuesday, October 24

D. F. Jones—9. General surgical operations.
D. F. Jones—2. Carcinoma of the rectum.
L. S. McKittrick—2. Radium treatment of carcinoma of the rectum.

Wednesday, October 25

F. H. Lahey—9. Thyroid and general surgical operations.
Elliot P. Joslin—2. Treatment of diabetes and its surgical complications.

Thursday, October 26

F. H. Lahey—9. Thyroid and general surgical operations.
F. H. Lahey—2. Clinic on thyroid disease.
B. E. Hamilton—2. Cardiac complications of thyroid disease and diagnosis of thyroid disease.
H. M. Clute—2. Postoperative care and complications of thyroid disease.
L. F. Sise—2. Anæsthesia in thyroid disease.
Sarah M. Jordan—2. Basal metabolism.

Friday, October 27

F. H. Lahey—9. Thyroid and general surgical operations.
F. H. Lahey—2. Clinic on thyroid disease.
B. E. Hamilton—2. Cardiac complications of thyroid disease and diagnosis of thyroid disease.
H. M. Clute—2. Postoperative care and complications of thyroid disease.
L. F. Sise—2. Anæsthesia in thyroid disease.
Sarah M. Jordan—2. Basal metabolism.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Tuesday, October 24

Isabel D. Kerr and Margaret L. Noyes—9. Nose and throat operations.
Blanche L. Atwood, Olga Leary, and Mabel D. Ordway—9. Unusual case of glandular enlargement with marked hypertrophy of the breasts and mental symptoms.

Wednesday, October 25

Elizabeth T. Gray and Florence Duckering—9. Gynecological operations.
Marion Nute, Eveline Lyle, and B. McW. Ryder—9. Obstetrical operations.
Mabel D. Ordway—2. Neurosyphilis.
Blanche Denig and Dr. Wright—2. Medical cases.

Thursday, October 26

Letitia D. Adams—9. General surgical operations.
Isabel D. Kerr—9. Nose and throat operations.
Staff—2. Obstetrical, prenatal, and post-natal cases.

FORSYTH DENTAL INFIRMARY

Tuesday, October 24

Percy R. Howe—9. Short talks on recent dental research.
Elmer W. Barron and Herman Robbins—9. Pediatrics as applied to dentistry.

Wednesday, October 25

William E. Chenery, E. E. Tilton, W. G. Funnel, A. A. Barrow, B. F. Murray and Louis Arkin—9. Adenoid and tonsil operations.
Louis Arkin—9. Adenoid and tonsil operations.
M. J. Eisenberg—9. Dental orthopedics.

Thursday, October 26

W. A. Gobie—9. Extracting.
Percy R. Howe and Ruth E. Hatch—9. Dental research laboratory demonstration.
Mary G. Jackson—9. Dental prophylaxis.

Friday, October 27

F. M. Erlenbach—9. Dental clinic.
Leroy M. S. Miner—9. Oral surgery.
E. W. Barron and H. S. Robbins—9. Nutrition, pediatric clinic.

BETH ISRAEL HOSPITAL

Wednesday, October 25

Albert Ehrenfried and Carl Bearse—9. General surgical operations.
Albert Ehrenfried—2. Hereditary deforming chondrodysplasia and certain allied growth distortions (with lantern slides).
S. A. Robins—2. A consideration of the diagnostic points in the interpretation of abdominal X-rays.

Thursday, October 26

E. G. Crabtree—9. Genito-urinary operations.

Friday, October 27

Wyman Whittemore and Maurice Barron—9. General surgical operations.

CAMBRIDGE HOSPITAL

Tuesday, October 24

J. W. Sever—9. Orthopedic operations.
A. H. Crosbie—2. Genito-urinary operations.

Wednesday, October 25

Albert August, E. A. Darling, A. W. Dudley, H. P. Stevens, and associates—9. General surgical operations.
N. S. Bacon and E. J. Butler—2. Demonstration of nose and throat cases.

Thursday, October 26

N. S. Bacon and E. J. Butler—9. Nose and throat operations.
J. L. Huntington—2. Prenatal clinic.
F. B. M. Cady—2. Neurological clinic.

Friday, October 27

Albert August, E. A. Darling, A. W. Dudley, H. P. Stevens, and associates—9. General surgical operations.

COLLIS P. HUNTINGTON MEMORIAL HOSPITAL

Wednesday, October 25

Clinic by Staff—2.

R. B. GREENOUGH—The cancer problem.
WILLIAM DUANE—Short wave length X-ray therapy.
HOMER WRIGHT—Free diagnosis service.
WILLIAM BOVIE—New contributions of physics to biology.
CHANNING SIMMONS—Radium in cancer of buccal mucosa and tongue.
D. CROSBY GREENE—Radium in carcinoma of jaw and larynx.
GEORGE MINOT—Radium in Hodgkin's disease.
G. G. SMITH—Radium in cancer of the bladder.
G. A. LELAND—Radium in carcinoma of cervix.
ERNEST DALAND—Radium in skin lesions, malignant and benign.
LELAND S. MCKITTRICK—Radium in cancer of rectum.

Friday, October 27

Clinic by Staff—2.

R. B. GREENOUGH—The cancer problem.
WILLIAM DUANE—Short wave length X-ray therapy.
HOMER WRIGHT—Free diagnosis service.
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G. A. LELAND—Radium in carcinoma of the cervix.
ERNEST DALAND—Radium in skin lesions, malignant and benign.
LELAND S. MCKITTRICK—Radium in cancer of rectum.

EVANGELINE BOOTH HOSPITAL

Tuesday, October 24

A. K. PAINE—9. Prenatal clinic.

Thursday, October 26

A. K. PAINE and STEPHEN RUSHMORE—9. Gynecological operations.

Friday, October 27

A. K. PAINE and STEPHEN RUSHMORE—9. Gynecological operations.

UNITED STATES NAVAL HOSPITAL

Tuesday, October 24

LIEUT. J. W. WHITE—9. Orthopedic operations: Keller operation for hallux valgus; arthrotomy of knee for internal derangement; osteotomy for malunited humerus; repair of finger tendon.

Wednesday, October 25

COMMANDER J. S. WOODWARD—9. General surgical operations.

Thursday, October 26

LIEUT. D. A. HEFFERNAN—9. Eye, ear, nose, and throat operations. Various manifestations of syphilis from an ophthalmological standpoint; enucleations of tonsils; nasal septum corrections. Demonstration of aural cases of acute nasal sinusitis requiring operation.

LIEUT. J. W. WHITE—2. Hallux valgus treated by the Keller operation, end-results and X-rays. Recurrent dislocation of the shoulder treated by the Clairmont-Ehrlich operation, end-results. Finger tendon repair, end-results. Malunion of femora treated by osteotomy, end-results. Generalized osteitis fibrosa treated by conservative means, end-results. Two cord injuries: one a persistent spastic hemiplegia, the other a complete recovery after a Brown-Séquard syndrome at the level of the sixth dorsal vertebra.

HARVARD MEDICAL SCHOOL

Tuesday, October 24

H. P. MOSHER and C. B. FAUNCE, JR.—2. Anatomical demonstrations. (Ear, Nose, and Throat Department.)

Friday, October 27

PROFS. W. B. CANNON, L. J. HENDERSON, C. K. DRINKER, and DRS. ALEXANDER FORBES, J. C. AUB, and A. C. REDFIELD—2. Demonstrations and talks on various physiological subjects of importance in surgery. (Department of Physiology.)

Dates to be Arranged

E. A. CODMAN—Registry of cases of bone sarcoma.